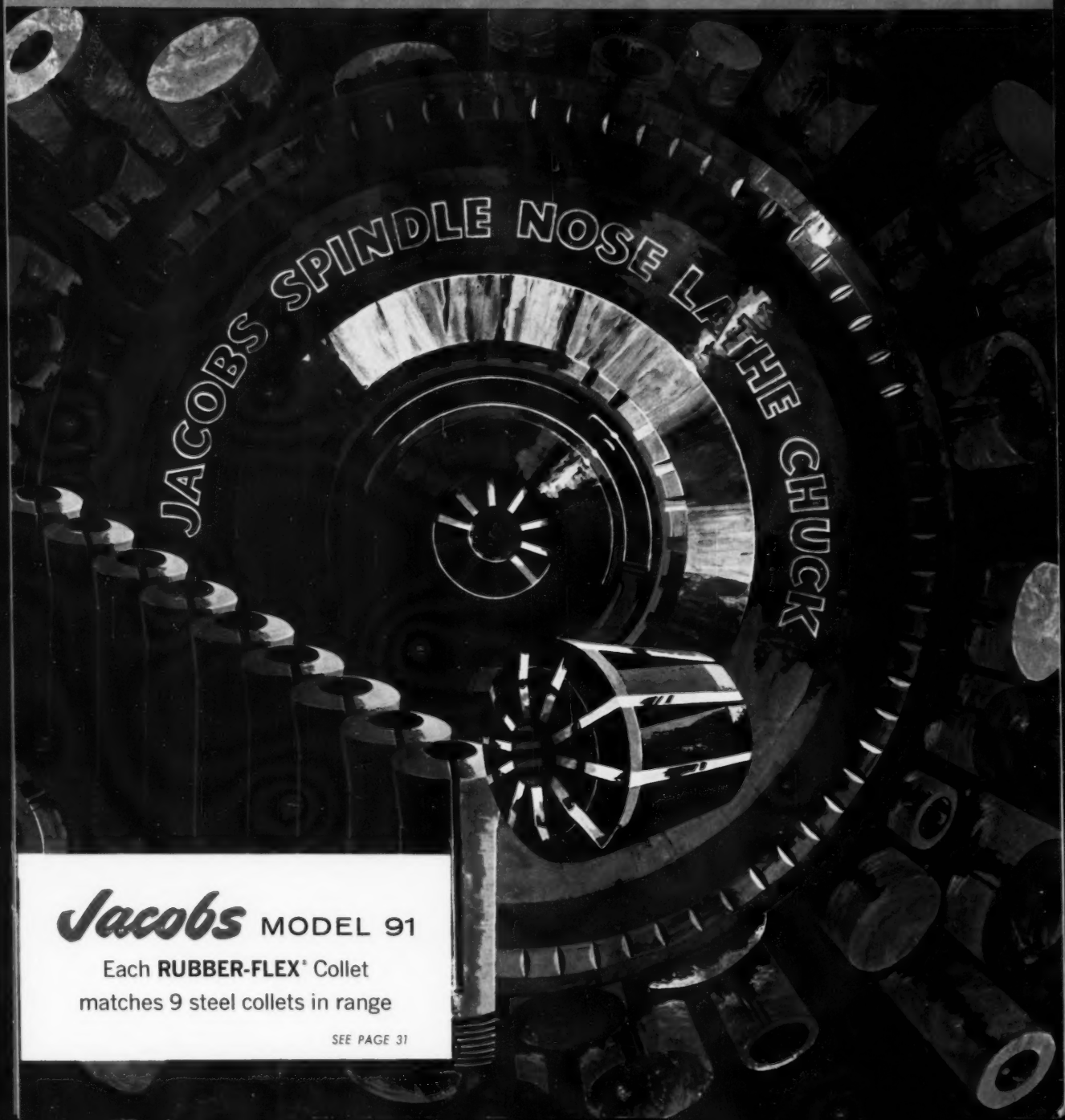
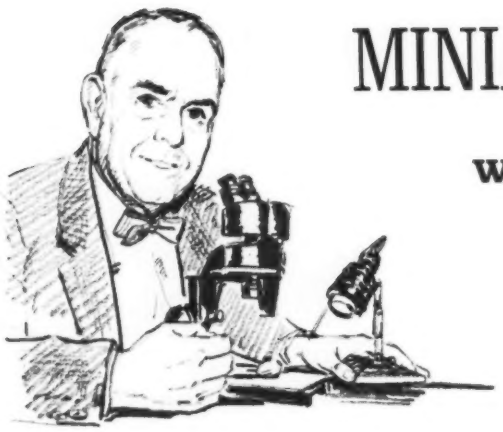
ENGINEERING AND PRODUCTION IN METALWORKING JUNE, 1961

Machinery





MINIATURE GRINDING...

With A New Problem-Solving Internal

by Stuart St. John
Assistant Sales Manager
The Heald Machine Company

Seldom does any new machine represent all the answers to the desires of production people. But the new Model 090A and 0901A miniature internal grinding machines come mighty close. In fact, these new machines constitute a major break-through in the ability to control variables inherent to miniature internal grinding. This, in addition to substantially faster machine cycles, was made possible through a complete analysis of all miniature grinding techniques. Based on the findings of our research and development engineers, this machine was designed, produced and has proved its capabilities most convincingly. Here are some of these developments which have been incorporated in the new design and which have placed these machines well ahead of their time by present-day standards.

NEW models provide simpler, more reliable and infinitely adjustable wheel-wear compensation from 0 to .001 resulting in substantially longer wheel life.

NEW, lighter-weight vibration-damped cross slide on anti-friction ways gives concise and consistent repeatability.

SIMPLER, more efficient control and equipment arrangement permits easy service inspection through hinged doors at rear. No access necessary from either end.

NEW models feature a 75% reduction in hydraulic and electrical control equipment, simplified circuitry and ⅓ smaller electrical cabinet.

NEW feeding method gives greatly improved control of size and taper, increases accuracy by as much as 50%.

NEW direct-reading micrometer dials permit cross slide to be precisely positioned without use of dial indicators.

NEW cross slide resets automatically for wheel change; at press of button, machine automatically dresses wheel and re-enters cycle with resultant saving of operator time.

NEW direct-reading digital dial shows operator the amount of wheel life remaining at all times.

NEW, simpler, 3-piece guarding retains all coolant yet opens easily to expose complete machine.

These and other improvements make the 090A and 0901A miniature internals that challenge *any other machines* intended for this class of work. Your Heald engineer will be glad to arrange a demonstration for you.

Heald Model 090A precision internal, designed specifically for grinding miniature bores. Smallness of bore is limited only by the availability of small diameter wheels.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
WORCESTER 6, MASSACHUSETTS

June 1961

VOL. 67 No. 10

Published monthly by THE INDUSTRIAL PRESS. ROBERT B. LUCHARS, *President;* EDGAR A. BECKER, *Vice-President and Treasurer.* Editorial, Advertising and Circulation Offices: 93 Worth St., New York 13, N. Y. Telephone, CAnal 6-8120.

Subscription rates: United States and Canada, one year, $10; foreign countries, one year, $15; two years, $28. Single copies, $1.00; foreign, $1.50. Changes in address must be received by the first of the month to be effective for the next issue. Send old as well as new address.

Accepted as controlled circulation publication at Bristol, Conn.

Great Britain
MACHINERY
National House, West St., Brighton 1, England
and
Clifton House, 83-117 Euston Road
London, N.W. 1, England

France
LA MACHINE MODERNE
15, Rue Bleue, Paris-IXe, France

BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

SHOP PRACTICE

MACHINE AND TOOL DESIGN

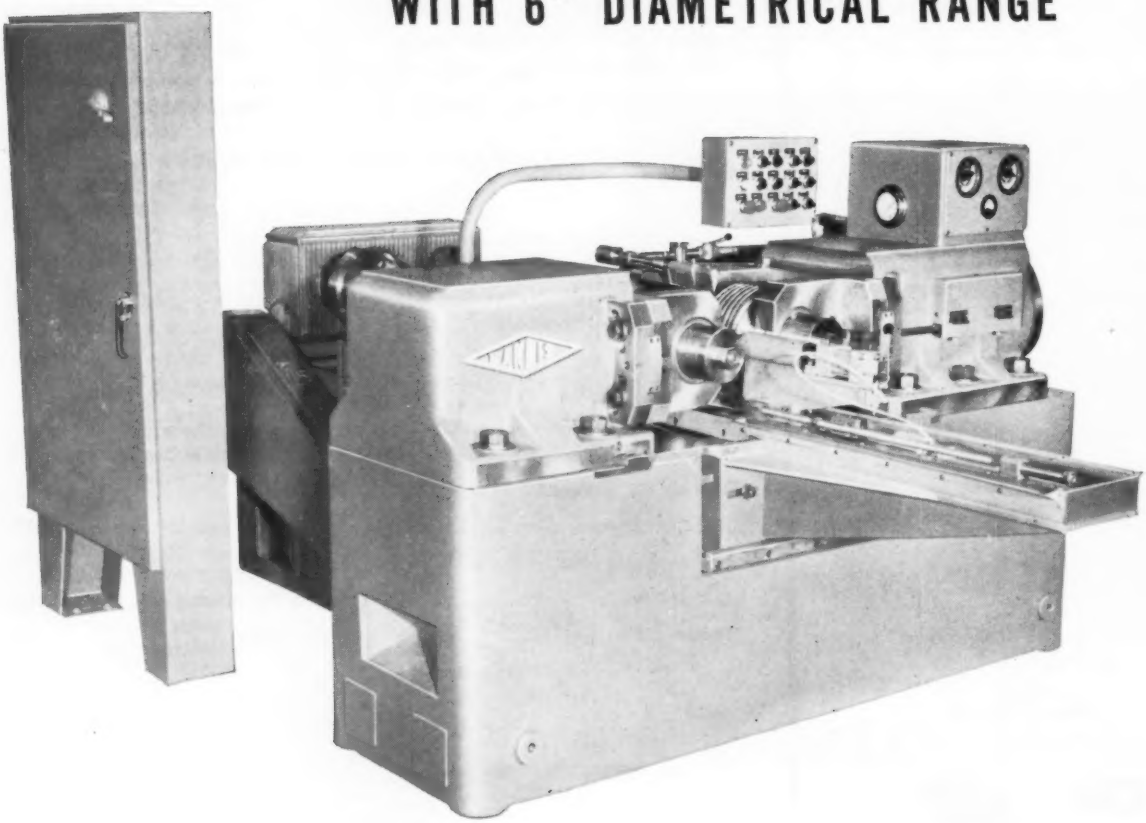
MANAGEMENT PROBLEMS

DEPARTMENTS

THREAD ROLLING MACHINE

delivers 200,000 pound rolling force

WITH 6" DIAMETRICAL RANGE



NEW

. . . from Landis Machine Company, the world's largest manufacturer of threading equipment, comes the HY-DUTY Thread Rolling and Forming Machine. With an all-steel bed, it is designed for the heaviest thread, form, spline and gear rolling applications . . . even those requiring rolling forces of up to 200,000 pounds.

With hydraulically operated, infinitely regulable and electronically-controlled infeed cycling and variable infeed stroke length, the machine is exceptionally versatile in application. It offers power, rigidity and speed for maximum efficiency within its rated capacity. The HY-DUTY will thread and form up to 6" maximum diameter INFEED, and up to 4" maximum diameter THRUFEED. A full complement of automatic feeding and tooling equipment is available for rolling by either method.

The HY-DUTY Machine complements the medium size LANHYROL and small LAN-NU-ROL Thread Rolling Machines allowing LANDIS to offer a complete line of thread rolling equipment. Whatever your thread rolling requirement, there is a LANDIS machine or tool to do the job. This is the result of over 55 years of experience in the threading field. For additional information about the HY-DUTY Machine, contact your LANDIS Representative (in all leading cities) or write direct for Bulletin E-104.

HY-DUTY FEATURES:

- Manual, semi-automatic and automatic die cycling
- High infeed cycling rates—up to 25 strokes per minute (fully automatic)
- Two die design to minimize set-up time and auxiliary equipment
- 50/25 H.P., 1800/900 R.P.M., motor and 12 spindle speeds ranging from 39 to 476 to provide the power and speed to efficiently roll all diameters within the machine's range
- Maximum thread lengths of 11½" for Infeed rolling, up to 20' Thrufeed
- Roll holders inclinable to 10° in either direction to include the helix angle of any standard AN/UN or Acme thread within the Thrufeed capacity of the machine
- 3" steel plate major bed for maximum mechanical stability
- Worm gear transmission and speed change gear box rated 90% efficient at maximum speed with overload capacity of 100%

LANDIS Machine COMPANY

WAYNESBORO • PENNSYLVANIA • U. S. A.

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

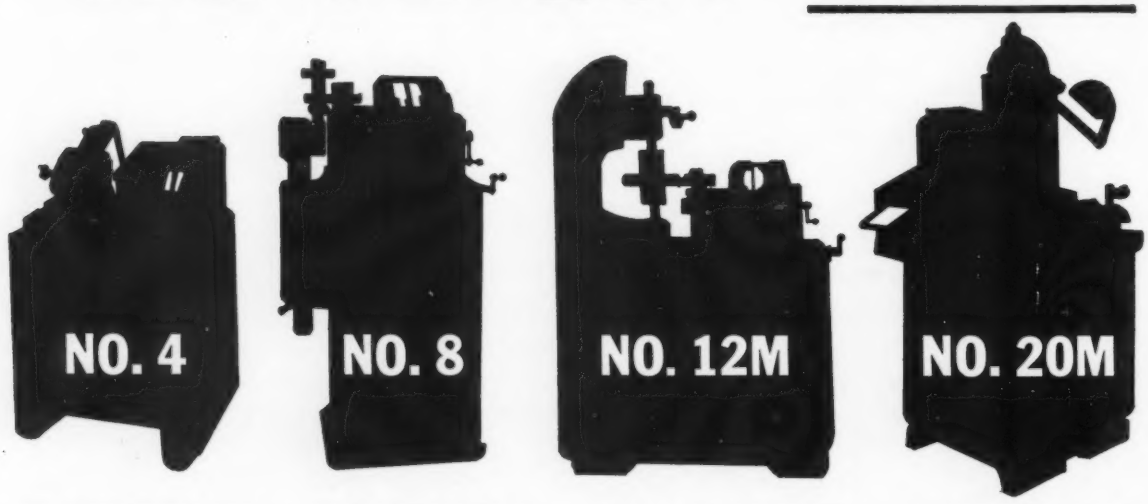
610C

On these pages you'll find the number of the FELLOWS gear inspection instrument that precisely matches your needs.

In fact, right from the gear blank to the finished external or internal spur or helical gear, FELLOWS has a complete line of gear production *and* inspection equipment.

One of the most important FELLOWS developments is the No. 4 Red Liner for fine-pitch gear inspection. It makes "composite" checks on the finest instrument gears with remarkable accuracy and sensitivity. Magnifications of 1600 to 1 are obtained thru the electrical recording system which provides a written, unbiased record for instant reading or for proof-of-accuracy files. It's the *best* way to check tiny gear components such as that shown actual size at top of right-hand page . . . a 22-tooth, 96 D.P. pinion backed up to an 80-tooth gear on a cluster.

WE'VE GOT YOUR



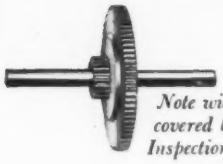
NO. 4 FINE PITCH RED LINER. For composite check of external and internal spur and helical gears. Maximum P.D.– 4″.

NO. 8 RED LINER. For complete check of external and internal spur and helical gears. Maximum P.D. depends on design.

NO. 12M INVOLUTE MEASURING. For external and internal spur and helical gears. Maximum P.D. — 12″. No. 24M — 24″ cap.

NO. 20M RED LINER. For complete check of external and internal spur and helical gears. Maximum P.D. — 18″.

Keep *your* production and inspection operations efficient and economical with today's most advanced gear manufacturing equipment. Get complete details on FELLOWS equipment from your nearest FELLOWS branch office.



Note wide range of size covered by Fellows Gear Inspection Equipment.

NUMBER!

NO. 12H LEAD MEASURING. Continuous-originating type lead measuring of external and internal helical gears. Maximum P.D. —12". No. 24H has 24" capacity.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE

Fellows

Gear Production Equipment

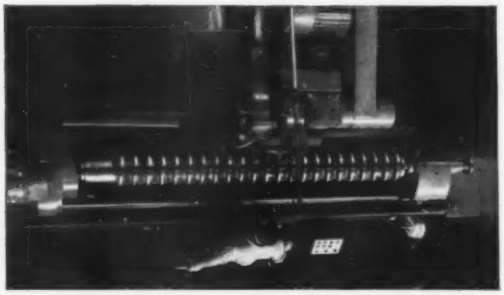
CINCINNATI

FILMATIC PLAIN GRINDER saves up to 35 hours in grinding hard-surfaced mixing screw

AT THE RIGHT you see a rough, tough part. It's rough because it has been hard-surfaced by welding. It's tough because, until recently, it taxed the ingenuity of manufacturing engineers to machine it.

The part is a 16″ diameter mixing screw, manufactured by a prominent builder of food and chemical machinery. The problem was to machine the OD of the flights to a smooth finish and at a reasonable cost. Formerly the part was turned on a lathe, requiring 35 to 45 hours. Too expensive. Now, the OD is *ground* in 10 to 15 hours! A CINCINNATI FILMATIC 24″x 120″ Plain Grinding Machine performs the operation, reducing cost by more than half. And, finish is of a much higher quality than ever before.

All CINCINNATI Centertype Grinding Machines are built to remove metal rapidly and to the highest standards of quality. Generously proportioned structural elements are one plus factor. Another is the dependable pressure lubricating system for the ways. And still another is the FILMATIC bearing mounting for the grinding wheel spindle . . . no adjustment ever required for extreme variables in stock removal. More information on CINCINNATI FILMATIC Plain and Roll Grinding Machines in the heavy duty sizes may be obtained by writing for Catalog G-709-1.



Tops in grinding heavy, hard stock and large work. It's easy for this new CINCINNATI FILMATIC 24″ x 120″ Plain Grinder. Catalog G-709-1.

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

Photographs courtesy of Baker Perkins, Inc., Saginaw, Mich.

Huge savings in time are gained by replacing turning with grinding to remove hard, heavy stock on the OD of mixing screws. A CINCINNATI 24" x 120" Plain Grinder performs the operation, grinding the rough, interrupted surfaces to a high-quality finish.

CINCINNATI

FILMATIC

• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®

GRINDING MACHINE DIVISION

allNEW Landis Type R Universal will improve your grinding accuracy, speed setups

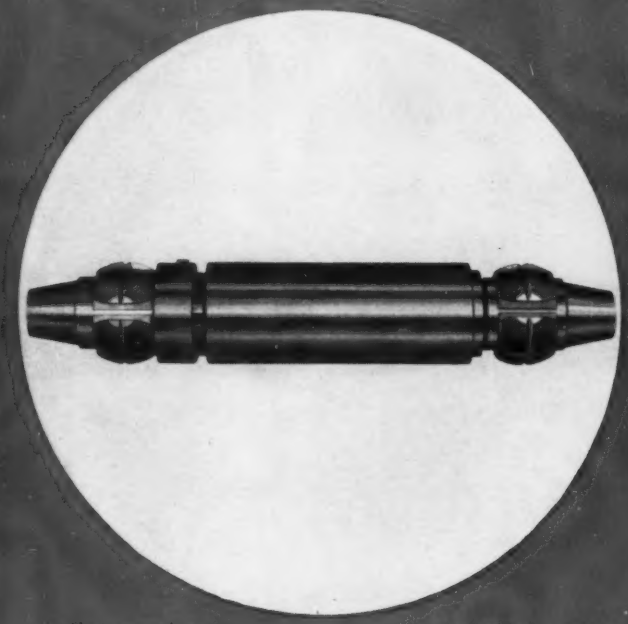
New Landis 14" x 36" R Universal Grinder

condensed specifications

	machine size 10" R	14" L R
Max. work swing	10 31/32"	14 3/4"
Lengths between centers	24"	36" - 48"
Standard grinding wheel	12" x 1" x 5"	14" x 1 1/2" x 5"
Work speeds—rpm (variable)	55 to 495	25 to 500
Traverse speeds—in. per min.	2 to 240	2 to 240
Wheel drive motor—hp.	2	3

Greater rigidity and balance of new swing type internal grinding fixture adds accuracy and convenience.

New hydraulic plunge feed available with turning handwheel to show rate and amount of feed.



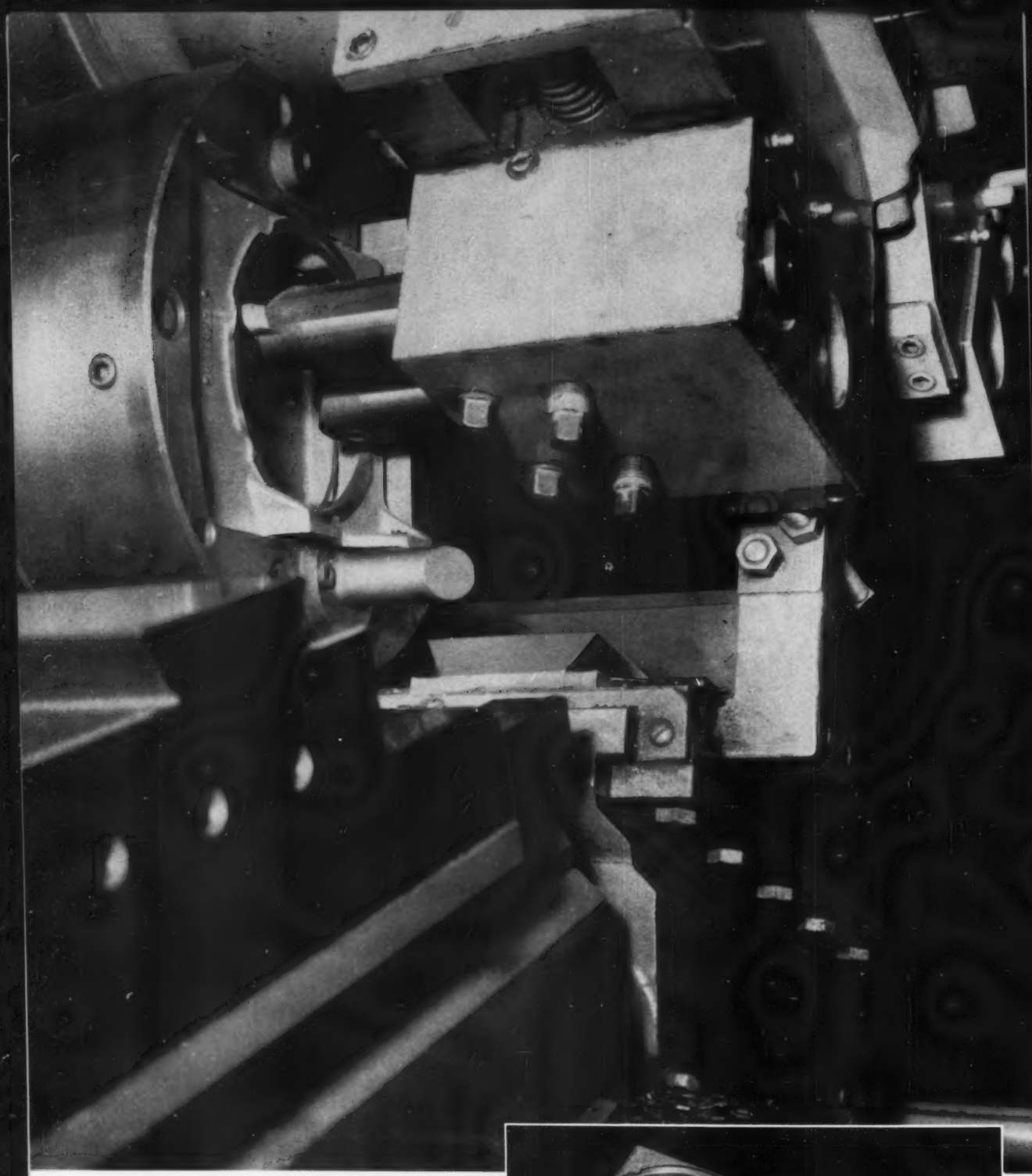
Exclusive Landis Microsphere wheel spindle bearings submerged in circulating and filtered oil.

Improved machine alignment through better temperature control. Hydraulic reservoir isolated from bed.

LANDIS

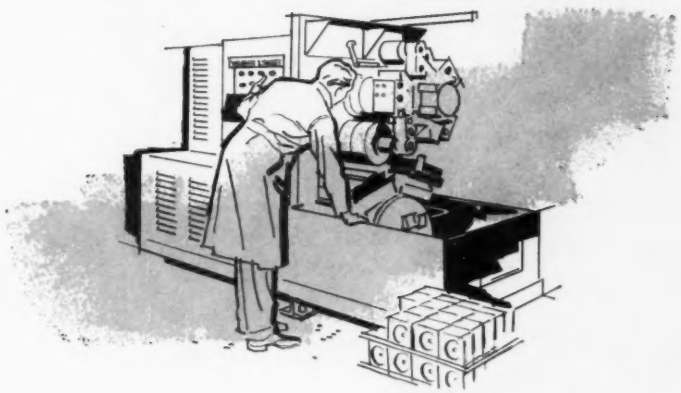
world leader in precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PA.



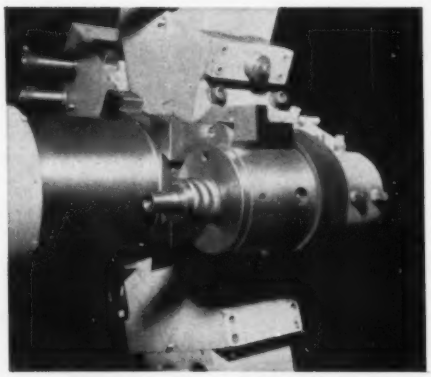
Lot sizes range from 100 to 300 pieces on these cast iron gear cases and covers. Note requirement for radial alignment of bushing so that its oil groove and the oil hole in the case will match properly. This is accomplished automatically in the job cycle.

AT GENERAL MACHINE COMPANY
Emmaus, Pa.



.0006" repetitive accuracy held by 2AC Chucking Automatic

Seven operations reduced to two on gear case and cover by unvarying size control and automatic assembly of ported bushing during machining cycle.



Bushing loading tool is engaged by an arm on the fixture so that the correct radial relationship is established between the bushing and gear case. Easy placement of multiple feed and speed change dogs in the machine permit reduced rate of engagement for gentle pick up, then fast return to bushing assembly stroke of tool slide.

Because of the unique overhead turret design of the Warner & Swasey 2AC, which houses both turret and spindle bearings in the same temperature zone, size variations due to spindle rise are eliminated. As a result, the shop people at General Machine found that they could easily hold single point boring tolerances of .0006" on a day-to-day basis.

This exceptional repetitive accuracy plus the 2AC's unique versatility and ease of tooling permitted them to machine gear cases and covers complete, ready for paint *in just two operations*—one chucking for each part, including pressing-in and size-boring a bronze bushing. Previously, seven operations were required—two machining, two arbor press, assembly of cover to case, line ream, and disassembly.

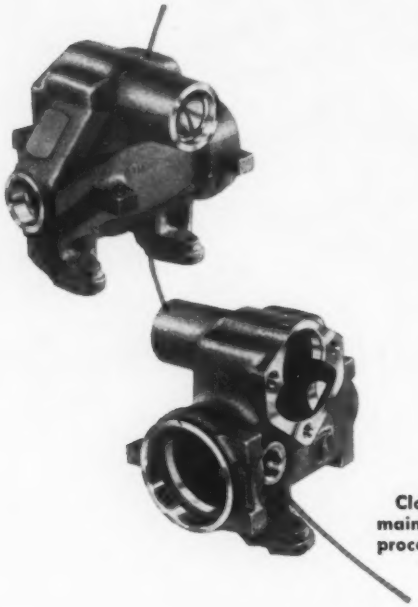
Five operations plus part handling and related paper work were eliminated!

Warner & Swasey Single Spindle Automatics can cut costs on your chucking work, too. Consult with your resident Field Engineer. Warner & Swasey Company, Cleveland 3, Ohio.

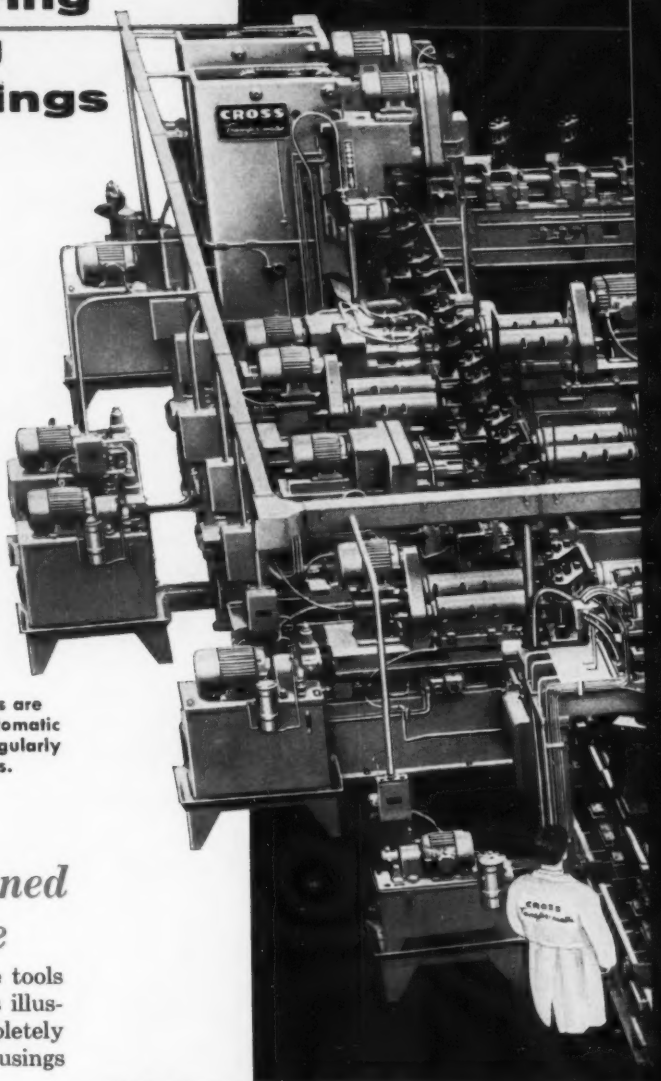
YOU CAN TURN IT BETTER, FASTER,
FOR LESS...WITH A WARNER & SWASEY

WARNER & SWASEY

Milling, Drilling, Boring and Assembling Steering Gear Housings



Close tolerances are maintained in automatic processing of irregularly shaped parts.



New Transfer-matic Designed to Prevent Obsolescence

A typical example of how transfer type machine tools can be designed to guard against obsolescence is illustrated by this new Cross Transfer-matic. It completely machines and assembles power steering gear housings except for the mounting feet.

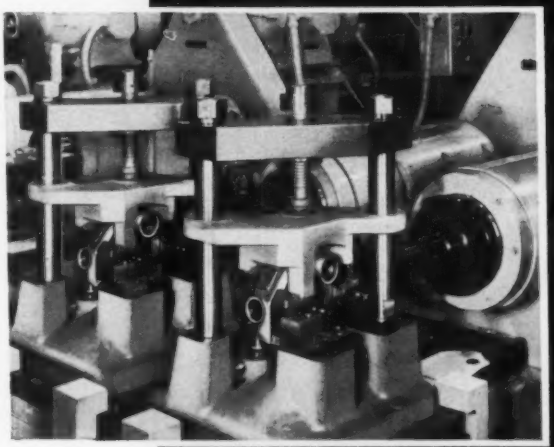
Useful life has been materially increased by building the Transfer-matic to process housings with longer pitman shaft extensions than those now being produced. Three idle stations permit other operations to be added and the use of standard Cross "building blocks" provides further flexibility for part design changes.

Present operations include milling, drilling, boring, counterboring, spot facing, chamfering, tapping, deburring, and assembling the worm thrust bearing cups and the pitman shaft bushings in the housings. Rated production is 300 pieces per hour.

A special feature is the provision for off-line inspection of the pallets and the parts without loss of production.

Another feature is the provision for in-line inspection at three different stations and final inspection just before the assembly operations.

If you would like to know more about these and other Cross innovations, just drop us a line.



Precision boring of the worm shaft hole—two at a time.

GRAY was the first to recognize the unparalleled advantages of the Norden System of Numerical Control when applied to a Gray Horizontal Milling and Boring Machine or a Planer Type Milling Machine.

Gray was the first to introduce this superior control that was jointly developed by Gray and Norden.

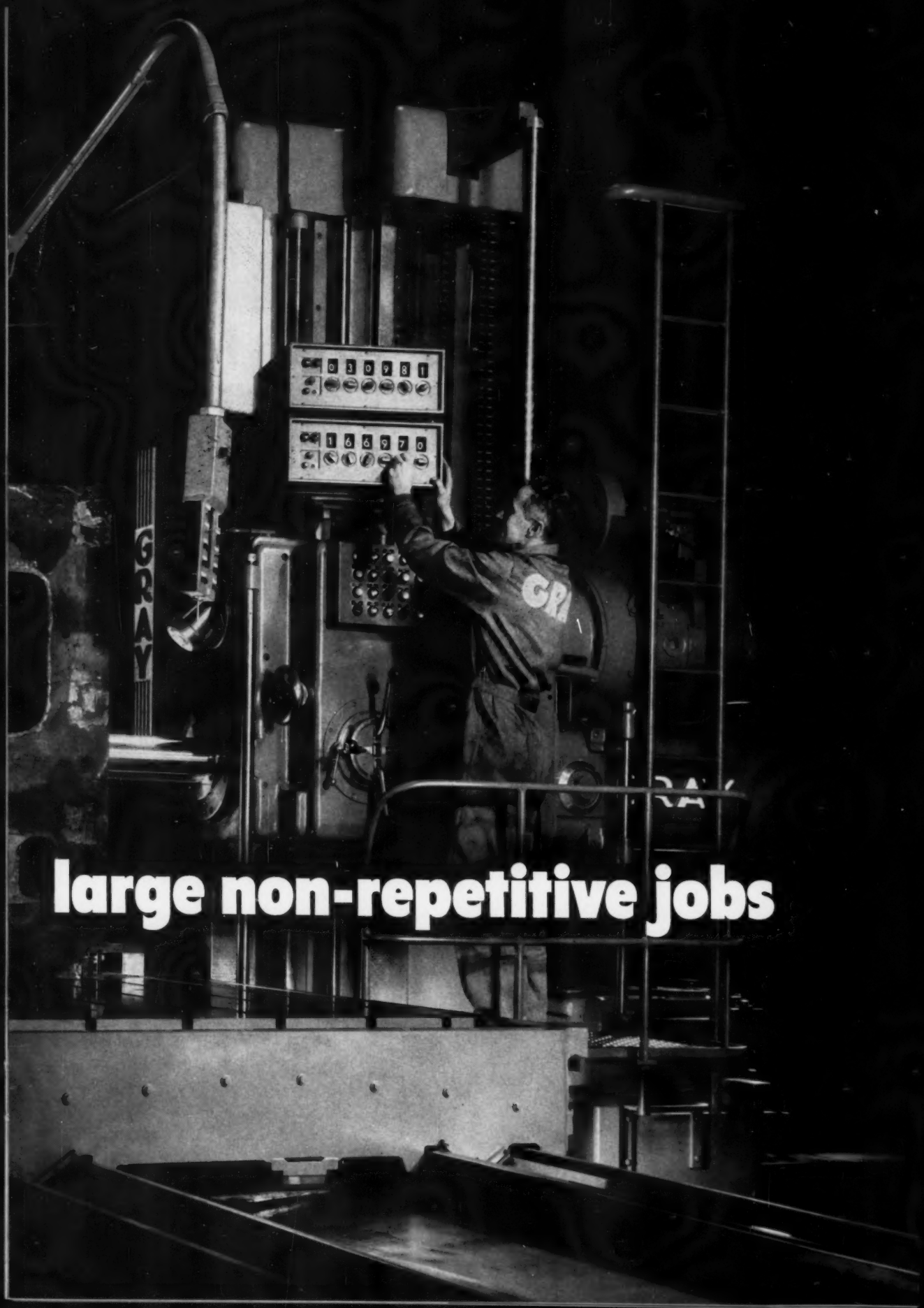
Consider these salient features:

- Read-out. A visual display clearly indicating at all times the exact location of a machine tool element.
- Zero Off-set. Ability to establish zero read-out on the display at any predetermined reference point on the work piece. Operator then reads drawing dimensions on display unit.
- Work to closer accuracies. Overall accuracies within .001". Unaffected by line voltage.
- Greatest productivity over prolonged period. Replaceable modular construction facilities quick servicing.
- Progressive steps to full tape control. Each phase may be purchased individually.

The G. A. GRAY Co. Cincinnati, Ohio

Horizontal Milling and Boring Machines
Planers • Planer Type Milling Machines

the perfect combination for


large non-repetitive jobs

This is AMERICAN OIL COMPANY

AMERICAN

A sales organization especially trained to serve industrial and fleet customers . . . 74 District Offices and 13 Regional Offices . . . 4,100 warehouses and distribution points . . . 12 refineries . . . more than 2,000 products to serve you . . . this is American Oil Company.

The American Oil Company representative who calls on you receives special training in servicing industrial and fleet customers at our Sales Engineering School. His training begins with a concentrated course in petroleum product quality and application. According to a planned schedule, he returns for an advanced course and then again for post-graduate work. From our Marketing Technical Service Department, your American Oil representative draws assistance, when needed, from specialists who are recognized authorities in their fields. These specialists may be called in at any time to work with you on your lubrication problems. More than a thousand research scientists and technicians at our research laboratory support the effort of our representative to serve you. Their mission: To help your American Oil representative help you lower your maintenance costs and stretch your maintenance dollars. Learn more about American Oil, its men, its service, its products.

AMERICAN

AMERICAN OIL COMPANY

910 S. Michigan Ave., Chicago 80, Ill.

Technical-ities

By Fred E. Graves

Fastening of rigid joints

Theoretically, there's no such thing as a rigid joint. There's always some elasticity of the fastened metals. For practical purposes, you can consider a joint rigid when the bearing areas of the metal-to-metal fastened members will not crush or yield before the full load-carrying capacity of screw or bolt is developed.

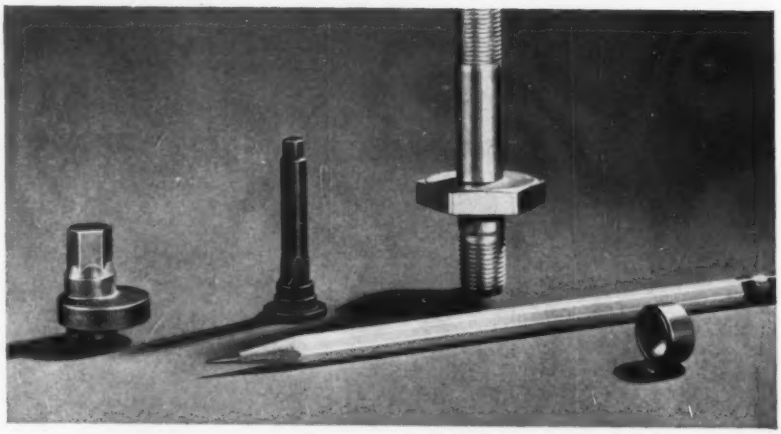
PRODUCT BENEFITS

Rigid joints afford a definite product advantage. They can take high strength hex screws or bolts tightened up to fastener yield strength or beyond. Under such tension, fasteners have demonstrated that they'll stay tight despite vibration. They are resistant to fatigue from the constant load reversals. High Strength Hex Screws cut costs and speed assembly too, since you can reduce *size* of the fasteners or their *number*, while actually improving joint strength.

INSTALLATION HINTS

When you're connecting steel members of fairly heavy section, you've no problem getting a rigid joint. Just clamp them to the full fastener capacity. Thin sections can be reinforced and similarly fastened. And in joining milder steels or softer metals, use of a plate washer will distribute bolt load, prevent crushing and give the desired effect of rigidity.

When to plan on cold-formed special parts



COLD forming is basically a large volume, low cost method of obtaining component parts.

Above you see four specific *types* of parts that benefit from this production method:

ECCENTRIC SHAPES

When the piece is radically eccentric, and is further complicated by having several different diameters, cold forming may prove the only way to produce the piece at a reasonable cost. Machining it from a bar would be prohibitive in scrap loss and machining time.

MULTI-DIMENSIONAL DESIGNS

When pieces are complicated, cold formers can often shape item in two or three blows. Tolerances are close enough for practical uses, and no further finishing need be done except for some secondary machining or drilling if required by the design.

ONE-PIECE PARTS

When simple, small two- or three-piece assemblies can be replaced with unit parts, the production man saves assembly time as well as material costs; the designer gets a stronger part. For example: stud with integral hex, square, or round upset anywhere in-between. Note the extreme upset shown.

PARTS WITH HOLES

Nut formers produce parts by the thousands per hour like the one shown above. Holes are punched out, leaving smooth, clean, work-hardened and strengthened surfaces.

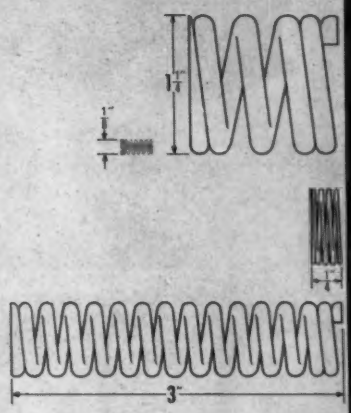
Bear in mind that unlike machining, cold forming cuts none of the metal's flow lines. So parts are tougher and more fatigue-resistant, as well as more economical.

As a fastener manufacturer, RB&W makes an ideal and experienced source of supply for such items. The same facilities used for standard screws and nuts can also pound out the required specials. Refer your problem to Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y.

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Sales office and warehouse at: San Francisco, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas.

DISC GRINDS WIDE RANGE OF SPRINGS

Gardner 2V18-24" vertical double spindle grinder. Capacity: spring diameter ⅛" to 1¼"
spring length ¼" to 3"
wire diameter 0.030" to 0.140"



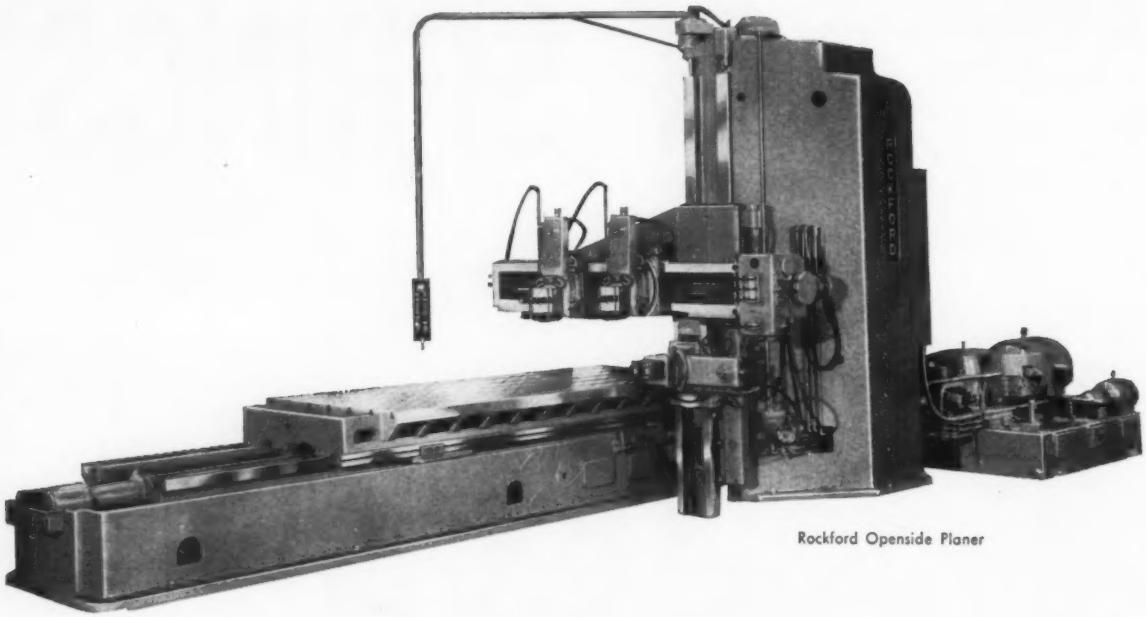
grinds **two** surfaces parallel in **one** operation

GARDNER

precision disc grinders

GARDNER MACHINE COMPANY, BELOIT, WISCONSIN
a subsidiary of Landis Tool Company

Rockford Hy-Draulic Machines mean more profits!



Rockford Openside Planer

OUR USERS SAY:

Press Brake Die Manufacturer:

"We are machining the tongues of steel press brake dies on a Rockford Hy-Draulic Planer at the rate of 2 *dies every 15 minutes.* Other methods take up to 7 hours per die."

Ship Builder:

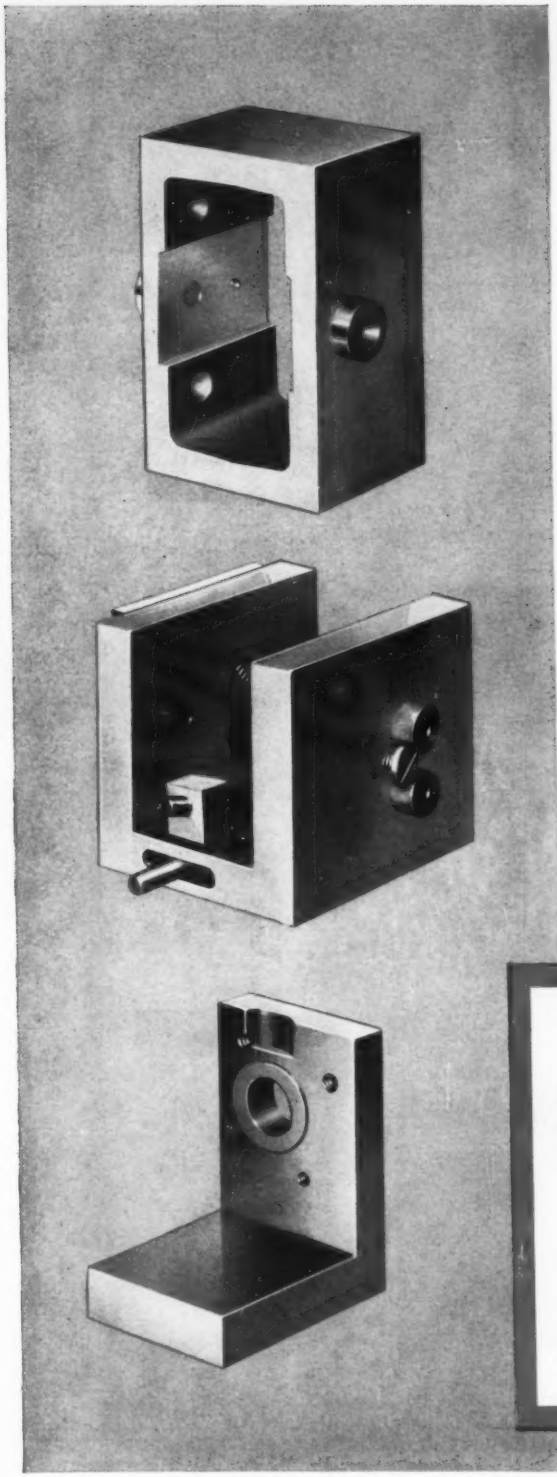
"Our Rockford Hy-Draulic Shaper-Planer paid for itself during the *first 18 months of operation.*"

Milling Machine Manufacturer:

"We have a good maintenance-cost record on all our machine tools. Our Rockford Shaper-Planers show less than *8 hours maintenance per year.*"

Let us show you how you can reduce operating costs and increase profits. Ask us for a comparison-study on your present equipment. No cost or obligation.

ROCKFORD MACHINE TOOL CO. ROCKFORD, ILLINOIS



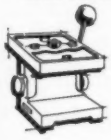
Build Fixtures Faster, at Lower Cost with Ex-Cell-O Micron Sections!

Available for immediate shipment, Ex-Cell-O Micron Sections are pre-machined square and parallel from high tensile strength cast iron to save you design and fabrication time.

Ideal for job-lot tooling, Micron Sections are cut to order from standard 25″ lengths. Wall thicknesses range from ⅝″ to 1¼″, with overall dimensions from 3″ x 3″ to 8″ x 10″.

Call your local Ex-Cell-O Representative or Distributor, or contact Ex-Cell-O direct. Phone TOwnsend 8-3900; TWX—DE 876; Wire ZTC.

COMPONENTS FOR ALL YOUR JIG & FIXTURE NEEDS—AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!



Lift Swing Fixtures for fast drilling of difficult holes.

Fixture Components Clamp Assemblies & Fixture Details.

Drill Jig Bushings Chrome alloy bearing steel • Tungsten carbide • Trans-Lok, Press-Lok for plastic jigs.

Reader Service Card Number is for Micron Sections Literature only. Request literature on above items separately.

61-19 BU

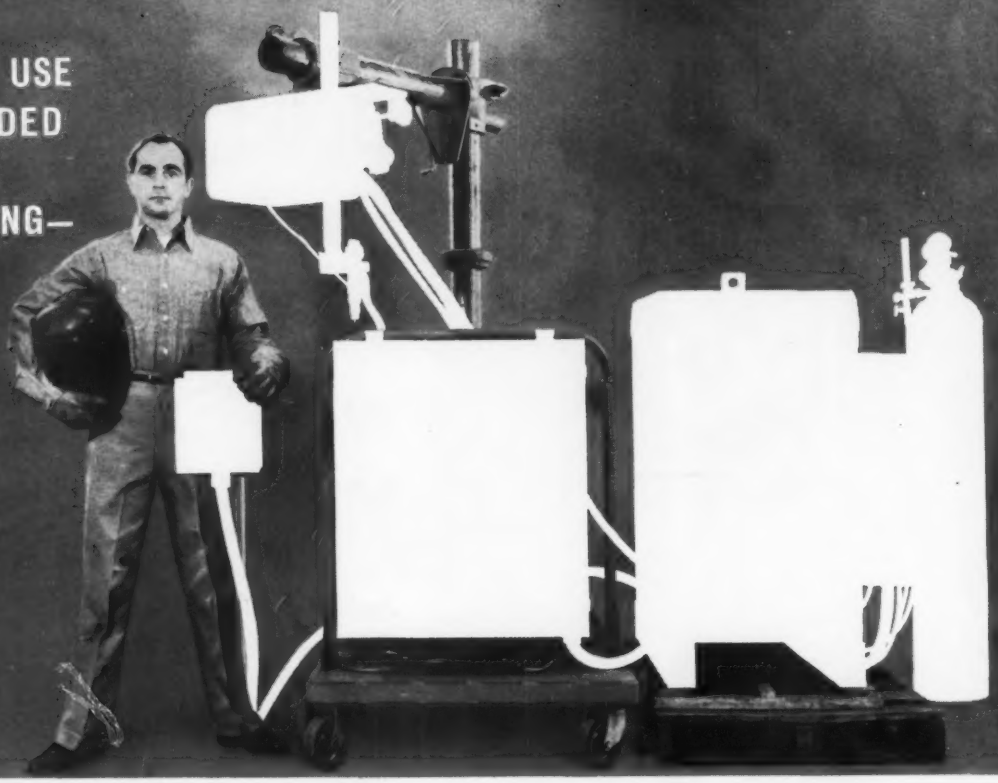
EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Bushing Sales Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

WHEN YOU USE GAS-SHIELDED TUNGSTEN ARC WELDING—



ONLY AIRCO'S HELIWELD LINE GIVES YOU EVERYTHING YOU NEED

A set-up for high quality specialized Heliwelding: Remote Control Station, Automatic Heliweld Head with Offset Arm, Control Panel, Arc Welding Machine, Flow-meter with Gas Regulator, High Purity Cylinder Gas . . . All-Airco matched components.

Planning to weld B-70 air frames? . . . Kitchen equipment? . . . Tubing by the mile? . . . Structurals for giant antennae? . . . ⅛" stainless, foil-fragile aluminum or anything between? **Then Heliweld it!** . . . You can weld it better with Airco inert gas tungsten arc Heliwelding than with any other process set-up available anywhere today!

Why? . . . Because you zero-in on the job. Choosing from the unmatched range of Airco equipment, you get a set-up that's specialized . . . that turns out top quality welds with the precise, unvarying penetration your job demands.

How is it possible? . . . The Airco Automatic Heliweld Head maintains constant arc conditions: the automatic Heliweld Head is more sensitive. It's far faster than human hands. It permits vast savings in hours and dollars.

That's just a fraction of the story. If you want to join metals with top quality welds, quickly and economically, there's one answer only. Call Airco . . . where the big idea is matched with unexcelled experience!

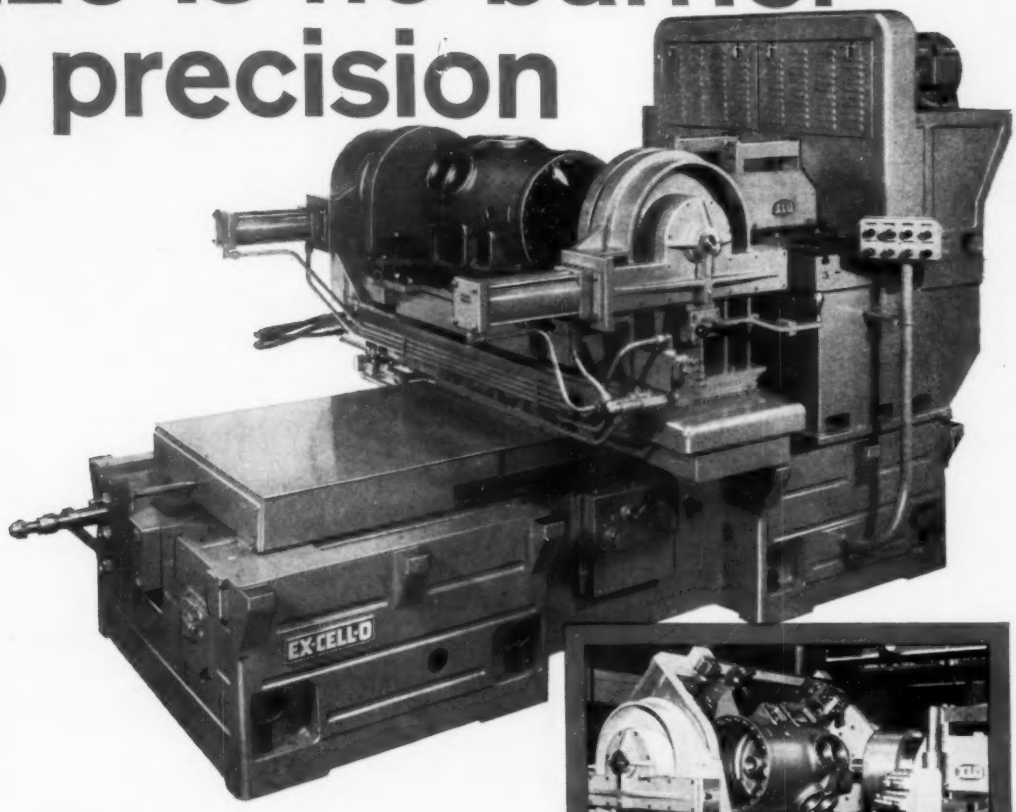
AIRCO®

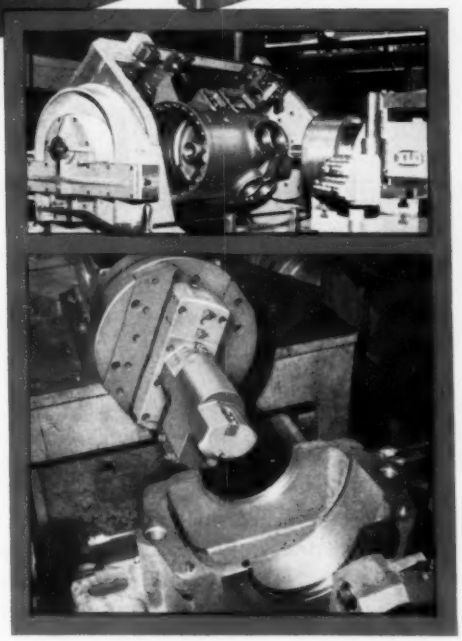
AIR REDUCTION SALES COMPANY

A division of Air Reduction Company, Incorporated
150 East 42nd Street • New York 17, N. Y.
More than 700 Authorized Airco Distributors Coast to Coast

On the west coast—Air Reduction Pacific Co., **Internationally**—Airco Co. Int'l., **In Canada**—Air Reduction Canada Ltd. • All divisions or subsidiaries of Air Reduction Co., Inc.

Size is no barrier to precision





HERE'S WHY SIZE IS NO BARRIER TO STANDARD EX-CELL-OS . . .

- Accuracy, heavy cuts and good finishes on large parts are the high-production features of Ex-Cell-O Models 771 and 772 (double-end) Horizontal Precision Boring Machines
- These precision-built workhorses have husky nickel cast-iron bases with wide-spaced ways, extra-strong tables to handle the heaviest fixtures and workpieces, and infinitely adjustable hydraulic feeds in both directions for maximum cycling efficiency.
- A range of standard spindles, bridges and drive equipment lets you custom-equip Models 771 and 772 to suit your particular precision boring, turning, facing, grooving and chamfering operations.

Contact your Ex-Cell-O Representative or write direct for details.

Typical of parts handled by Models 771 and 772 are large air conditioning compressor housing castings (main illustration and close-up above), and cast-iron pillow block bearing support housings (bottom photo). Machine takes $\frac{5}{8}$" cut as it roughs, finish-bores, and generates interior form of support housing in a single cycle.

61—59M

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

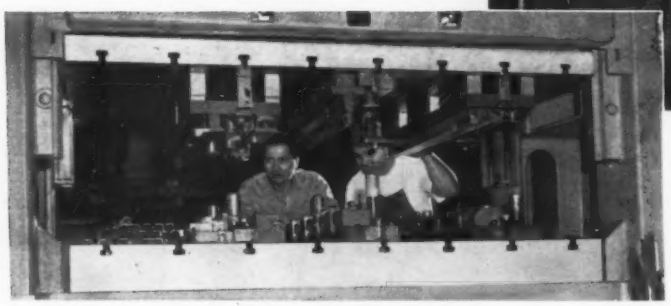
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

O'Keefe & Merritt Performs 4 Operations on Gas Range Side Mouldings Simultaneously in this 200 ton

Verson

Eccentric Press



Operator in front of the press removes finished piece, positions part from 3rd die to 4th and 2nd to 3rd. Operator in rear, not shown, positions part from 1st die to 2nd, wipes next part and places it on 1st die. (Operations are: 1. forming, 2. forming, 3. pierce and notch, 4. finish form.) For optimum safety both operators must hold both hands on buttons until press has bottomed.

By employing a Verson 200 ton Eccentric Press to form a variety of appliance parts, O'Keefe & Merritt Co., Los Angeles appliance manufacturer is realizing substantial production savings and obtaining high quality stampings.

The press, shown above producing gas range mouldings, has been tooled to perform four operations on every stroke . . . Machinery once tied up is freed for other jobs, productivity of floor space is increased and labor costs are reduced.

If your profit picture can be improved with press versatility and efficiency, you will be wise to investigate the advantages that Verson offers. For more information, contact your Verson Representative today. Or write for Catalog G-60 which describes the entire Verson line.

Verson

Originators and pioneers of allsteel stamping press construction

VERSON ALLSTEEL PRESS CO.

9309 S. Kenwood Avenue, Chicago 19, Illinois • 8300 S. Central Expressway, Dallas, Texas

251

MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES

TRANSMAT PRESSES • IMPACT MACHINING PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS

Ex-Cell-O Drill Jig Bushings

Uniform Hardness, Uniform Quality in More Than 11,000 Cataloged Bushings for metal or plastic jigs!

In stock now from coast to coast, Ex-Cell-O Drill Jig Bushings are made from the finest chrome-alloy bearing steel, precision-ground inside, outside and under the head. Steel bushings are held to consistent 62-64 Rockwell C Hole hardness.

Ex-Cell-O carbide bushings are made from the finest material available.

Select from one of the largest inventories in the U. S.

FREE DATA—See your local Ex-Cell-O Representative or Distributor for catalogs and bulletins on Drill Jig Bushings and other jig and fixture cost-cutters. Or contact Ex-Cell-O direct: Phone TOwnsend 8-3900; TWX—DE 876; Wire ZTC.

COMPONENTS FOR ALL YOUR JIG AND FIXTURE NEEDS—AVAILABLE IMMEDIATELY FROM A SINGLE, RELIABLE SOURCE!

Fixture Components—Clamp assemblies and fixture details.

Lift-Swing Fixtures—For fast drilling of difficult holes.

Micron Sections—Cast-iron shapes precut to your needs.

Reader Service Card Number is for Drill Jig Bushing Literature only. Request literature on above items separately.

61-18 BU

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Bushing Sales Division

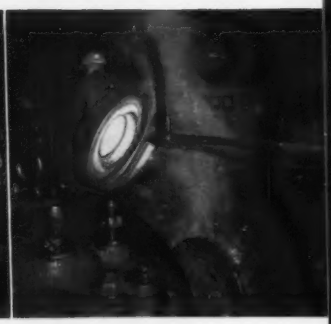
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

START: Heated billet is centered between dies of the Slick Mill.

15 SECONDS
Upset-forging starts.

30 SECONDS
Rolling cycle starts.

40 SECONDS
Forging is completed.



55 SECONDS
Forging is removed from mill.

One minute... one circular forging

That's all the time it takes to convert a heated billet (100 to 2,000 lb) into a contoured forging on Bethlehem's unique Slick Mill.

But fast operation is only one reason why Bethlehem's Slick Mill turns out a top-quality forging at a price that's hard to match.

Ask us, or our nearest sales office, about the quick die changes, which make it possible—and economical—to set up production runs as small as 25 or 50 pieces. Ask about the low die charges which are made possible by the brief contact between die and work. Ask about the light-weight sections this mill can produce, without sacrificing strength.

We'd also like to tell you about the excellent grain flow, machinability, and soundness of every Bethlehem circular forging.

Ask. You'll like the money-saving answers.

Steel *for Strength ... Economy ... Versatility*

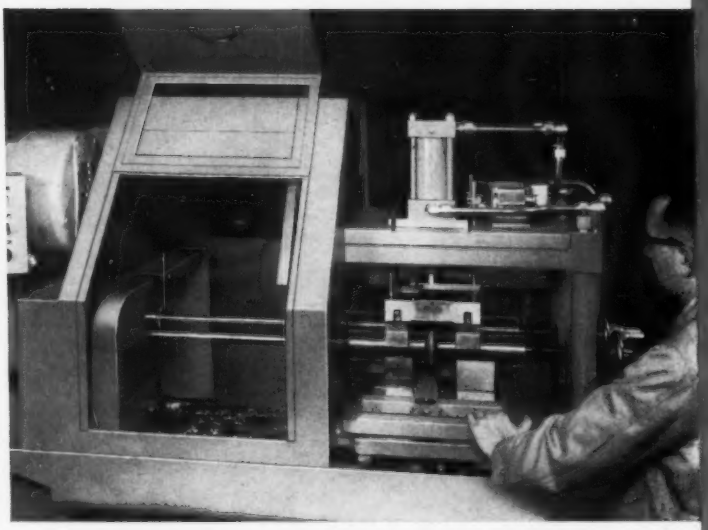
BETHLEHEM STEEL COMPANY, Bethlehem, Pa.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Deep Holes...Fast and True... with Ex-Cell-O

BOR-DRIL



Drilling 11/16" diameter holes the full length of 22½"-long forgings posed a tough problem for production engineers who need the economy of volume output, the time-savings of one-step operations, and the performance of precision equipment. But they found the answer in Bor-Dril, Ex-Cell-O's process for gun-type drilling with standard production boring machines.

Measured in terms of production efficiency, the result is 20 pieces per hour, from an Ex-Cell-O Model 752 Precision Boring Machine set up for Bor-Drilling. Secondary operations are eliminated.

Bor-Dril can be applied easily and economically wherever you have long, small-diameter holes to produce to precision tolerances. See your Ex-Cell-O Representative, or submit your requirements direct to Ex-Cell-O for prompt analysis and cost estimate.

The Bor-Dril process produces in one pass straight, smooth holes through track roller shafts 22½" long and weighing about 75 pounds each. Production is 20 pieces per hour on the two-station machine.

60-30

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

NEW ARMSTRONG CATALOG

Quality Tools for Industry

New ARMSTRONG General Catalog #700, showing the complete ARMSTRONG Line, has been released. This catalog lists approximately *330 tools that have not been included in previous* ARMSTRONG Catalogs.

Additions have been made in the following categories:

Tool Holders
Set-Up-and-Hold-Down Tools
Tool Bits
Wrenches
Ratchet Wrenches and Sockets
Miscellaneous Hand Tools
Pipe Tools

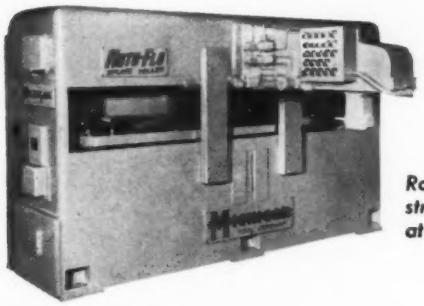
Get your free ARMSTRONG Catalog No. 700 showing these important additions, as well as the thousands of other tools included in the ARMSTRONG Line. The catalog is a necessity for anyone who uses or buys hand tools or shop tools. Write direct, or phone your local ARMSTRONG Distributor (who has a supply of new catalogs on hand). If you do not know which distributor in your area carries the ARMSTRONG Line, we will be glad to supply this information upon request.

ARMSTRONG BROS. TOOL CO. 5213 W. ARMSTRONG AVE. CHICAGO 46, ILLINOIS

SOLUTIONS TO GEAR PROBLEMS

PROBLEM: TO BOOST TRACTOR AXLE SPLINE STRENGTH WITHOUT HIGHER COST

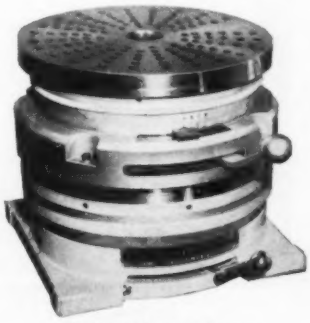
To increase strength of tractor axle shafts produced by a major manufacturer without increasing diameter, Michigan recommended the use of a Roto-Flo machine to cold roll the splines. This resulted in a 60% increase in torque load capacity due to the cold working at the normally weakened section. The "chipless machining" process reduced stress concentrations by 37% and increased production rate three-fold over the slower previous hobbing method. The same machine is used for different sizes of shafts. There were also major savings in tool costs over hobbing.



Roto-Flo gives stronger splines at lower cost

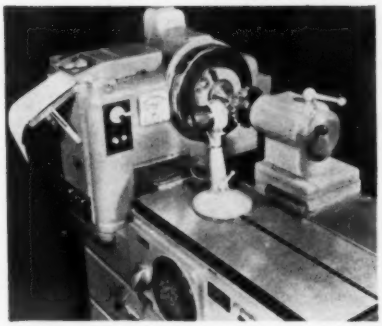
PROBLEM: NEEDED FAST ACCURATE INDEXING IN ¼ DEGREE INCREMENTS

Operations performed on a missile part required extremely accurate indexing in quarter degrees. Precision indexing tables used before required special gage blocks, trigonometry tables and a lot of time. Michigan's answer was a double table version of its Milichex rotary indexing table. This new version, Model M2X-900, provides instant indexing to ¼ degree settings with an accuracy of ¼ second of arc. No gage blocks or trig tables are needed. Operator merely indexes upper and lower tables to proper settings and Milichex automatically locks into exact angular position.



This Milichex indexes in ¼° increments

PROBLEM: 100% CHECK OF GEAR TOLERANCES TO TENTHS IN PRODUCTION

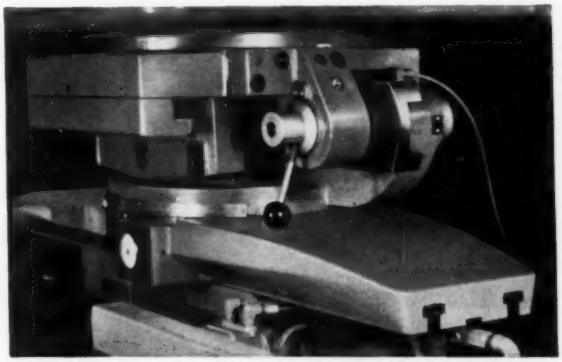


Production lead checking to laboratory tolerances on a 1218-A

A jet engine production bottleneck was the time required to accurately check the lead angle of gears to 0.0003 inch. A Michigan Sine Line 1218-A Lead Checker answered this need. Originally a 'laboratory' type checker, the machine with its precision optical system eliminates the need for "operator feel", records all checks, has the ruggedness for continuous production checking.

PROBLEM: TO SHAVE ANY COMBINATION OF CROWN & TAPER ON SAME MACHINE

Solved by a compact attachment for the Mark II shaving machine. Setting permanently installed attachment to scale controls amount of taper. An eccentric bushing in the attachment controls taper independently. For uncrowned untapered gears, both are set to 'zero'. Gears can be tapered or crowned with either transverse or modified underpass method. For spur gears, underpass method can also be used.



Taper & crown attachment for the Mark II gear shaver

MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

Greater **POWER**-*to-weight ratio!*

Cleco

W-1000

impact wrench

Exclusive single-pak power unit . . .

Increases production. An operator's dream. Lighter, shorter, with a faster run-down, impacting to a higher torque quickly. Bolt-tension values are greater. Safer locking socket-retainer* reduces socket expense and down-time. Slim nose gets into previously inaccessible areas. Easier throttling action. The dead handle is adjustable 360° or completely detachable, with no bulky boss left on casing.

Delivers greater power with less weight. Advanced Cleco design insures positive engagement of the hammer and anvil for *every* blow. This transmits maximum torque without the use of intermediate members. It is the *only* 1¼" impact wrench in which the impact mechanism is a part of the air motor. The one-piece casing houses fewer moving parts, reducing the weight 41% from previous models.

Lowers maintenance costs and reduces parts inventory. This tool is a dollar saver! Exclusive one-piece casing design—the essence of simplicity—houses fewer moving parts than comparable tools. The W-1000 is cammed into full engagement with every blow, minimizing wear on anvil and hammer surfaces. Entire assembly is line-bored for perfect alignment. Peak performance is *yours* 100% of the time.

The Cleco 1¼" bolt-size W-1000 Impact Wrench can be in your shop for a demonstration-tryout soon. Check the yellow pages for the number of your nearest Cleco representative today!

"quality tools engineered for industrial progress"

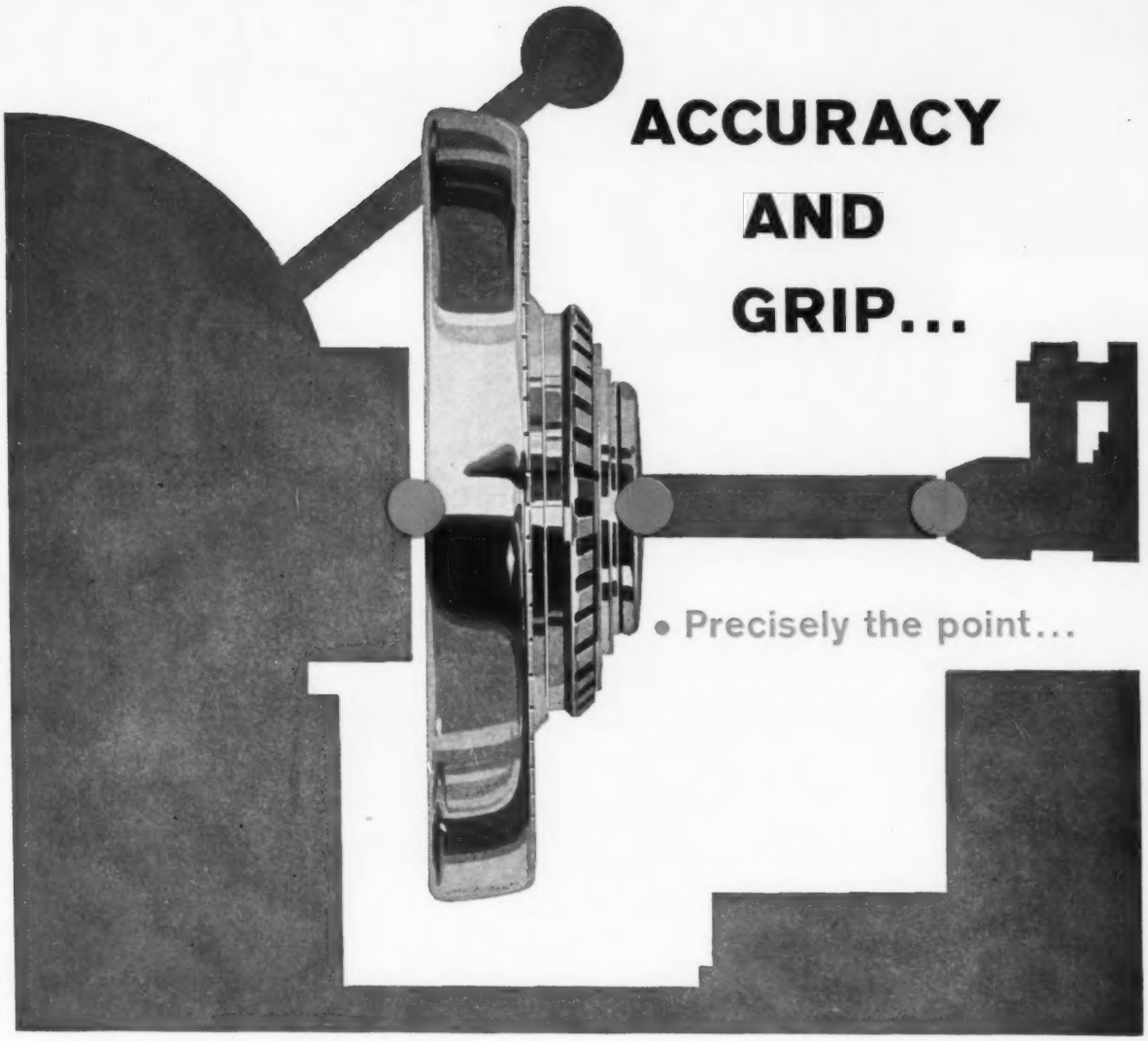
CLECO
AIR TOOLS

A DIVISION OF REED ROLLER BIT COMPANY

P. O. Box 2541, Houston 1, Texas, U.S.A.
IN CANADA: Cleco Pneumatic Tool Company of Canada, Ltd.,
927 Millwood Road, Leaside (Toronto), Canada

**Patent Pending*

For more data circle this page number on card at back of book



When you buy new tools or rebuild old ones

START UP FRONT

- Precisely the point where the tool does its work.
- Precisely the point where profits are made and lost.
- Precisely the point where the accuracy and grip of Jacobs Chucks reduce tool breakage, downtime and rejects.

This is precisely the point, start up front with Jacobs.

The Jacobs Model 91 is the world's finest lathe collet chuck. Developed expressly for the world's finest engine and tool room lathes. Modernize your lathes with Model 91.

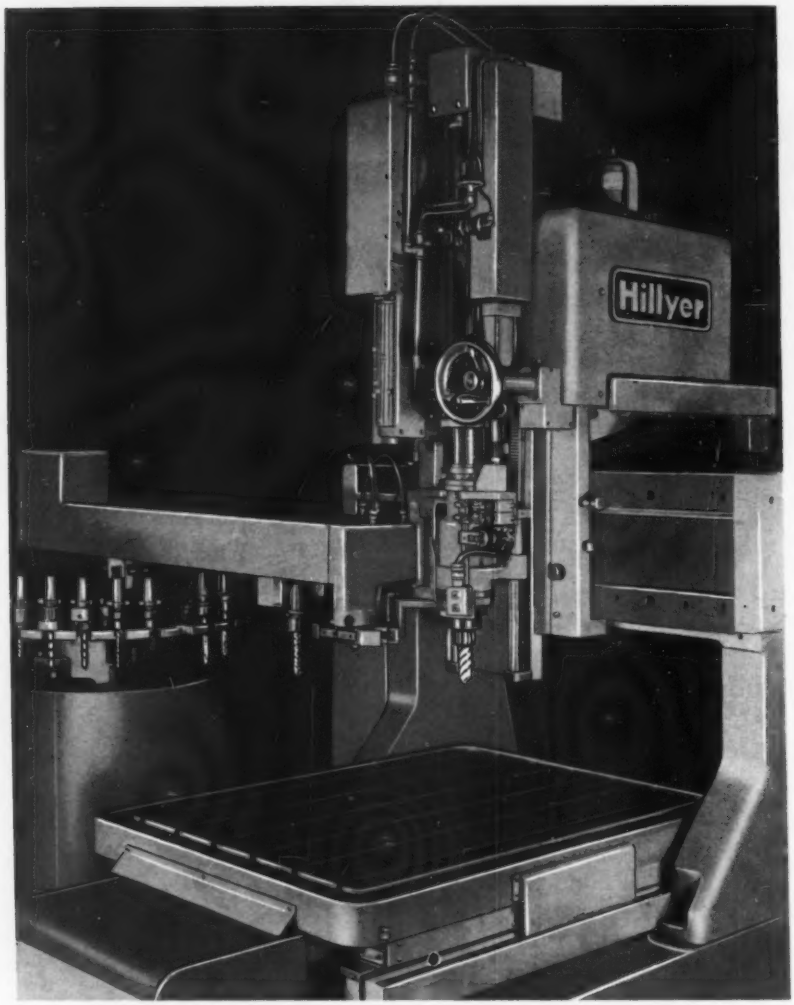
- It has the **range**—each collet has full 1/16" range and set of 11 chucks any bar between 1/16" and 1 3/16".
- It has the **grip**—two to four times as much as split steel collet equipment.
- It has the **accuracy**—the world's most accurate collet chuck. Manufactured to maximum runout limits of .0007"—T. I. R. at the nose.

INDUSTRIAL TEAMWORK

Your industrial supply distributor knows your business. He is always ready to fill your needs quickly and economically. When you need chucks you can depend on this industrial team—Jacobs and your Jacobs industrial supply distributor.

Jacobs CHUCKS

THE JACOBS MANUFACTURING COMPANY,
WEST HARTFORD, CONNECTICUT



A numerically-controlled drilling machine with AUTOMATIC TOOL CHANGER for just $41,500

Hillyer's new tape controlled drilling machine with AUTOMATIC TOOL CHANGER is **substantially less than its closest competition** — with features superior to them all! In addition to complete numerical control of all drilling, reaming, tapping and straight-line milling operations, the Model TC-36C automatically changes tools as designated by dial or tape. Any combination of spindle speed, feed rates, or depths can be selected at any time by dial or tape command. Any combination of these three variables can be selected at any time. And the machine permits a given tool to be programmed to varying levels and varying depths, all on the same work piece, all within a working range of 36″ x 24″. A total of 30 tools can be accommodated in the changer at any one time **— yet tool changing takes just seconds!** Complete cost: from $41,500. Write today for complete details to Dept. 321.

Hillyer
CORPORATION
244 Sheffield St., Mountainside, N.J.

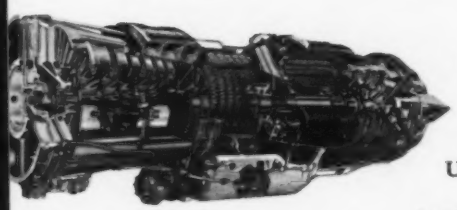
Production Pointers

from GISHOLT

More cost-cutting IDEAS—
to help you

NEW BALANCING METHODS SAVE FOR UNITED AIRLINES

Two units, one automatic . . . one double-tooled, speed maintenance balancing of jet engines . . .

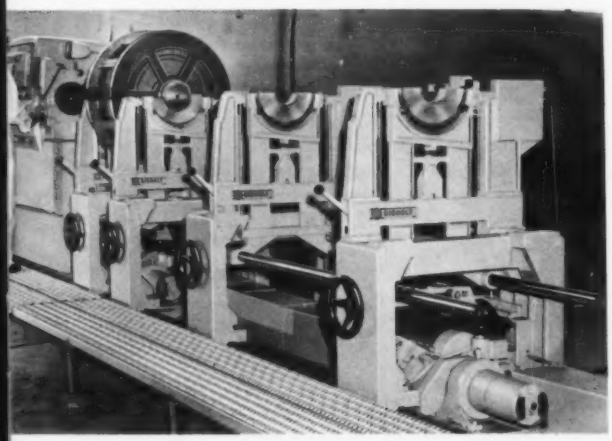


JT-3 Jet Engine

Unbalance causes vibration, and trouble . . . especially in the rotating heart of a jet engine. To assure continued safe operation, jet engines must be overhauled periodically. This installation in United Air Lines' Turbine Overhaul Facility, at San Francisco's International Airport, shows how low cost and peak efficiency can be obtained in maintenance balancing operations.

United Air Lines uses Pratt & Whitney JT-3C6, JT-3C7, JT-4A3 and JT-4A9 engines. Two Gisholt Balancers were selected for this installation. They had to comply with rigid performance tests based on Pratt & Whitney's specs. They also had to offer fast changeover, low tooling costs, and capacity for all parts and assemblies for all four engines.

A vertical 2SV1 Balancer is used for separate components requiring single plane (static) balancing. During rotation the 2SV1 automatically remembers angle and shows amount of unbalance in terms of the correction method used. After rotation, the operator indexes the part until a light flashes, indicating where correction should be made. All seven stages of a low compressor can be balanced, corrected and inspected in less than one hour.



Gisholt UJP Balancer with two sets of work supports. Shown with a JT-3 Rear Compressor assembly in one set of supports. The other set has been readied for a different type of part. Setups can be made for two plane balancing, or single plane (static) with a check for moment unbalance.

Gisholt 2SV1 Balancer arranged to balance front compressor part. A safety clamp device which fits over the center of the part has been removed to show detail. Power loader moves work from conveyor to spindle adapter. During work rotation operator notes amount . . . selects corrections weights. He stops rotation, indexes work to angle and makes correction. Work is rotated again to inspect for balance. Total time—2 minutes.

Even though components are balanced separately, tolerances accumulate during assembly. Complete units must also be balanced in their own bearings. Some weigh as much as 1500 lbs. This work is done on a Gisholt UJP Balancer. Special foundations are not required although vibrations as small as .000007″ can be measured and located.

The UJP Balancer has two complete sets of work supports. One can be set up for a new part while the other is in use. Non-operating time is at a minimum. Two-machine production is obtained at 1½ times the original cost of a single machine.

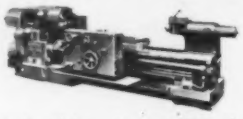
Here are typical balancing times: high turbine—5 minutes; low turbine—½ to 1 hour; high compressor—½ hour; low compressor—1 to 1½ hours. This includes loading, location, measurement, correction and inspection for balance.

Gisholt Balancers save time, offer top accuracy, eliminate guesswork. Special UJP Balancer gives two-machine production at cost and floor space of 1-1/2 units.

For information on Balancers, circle No. 750 on inquiry card.

HARNISCHFEGER SAVES UP TO 30 MINUTES PER PART WITH GISHOLT CRI-DAN

. . . Single-point tools thread tough steel to high accuracy . . . fine finish



Want to cut costs from 30% to 80% on the toughest threading jobs in your plant? Then study this setup at Harnischfeger Corporation, Milwaukee, Wisconsin. It shows how you can use inexpensive single-point carbide and high speed tools to produce top quality threads, simple or complex, automatically!

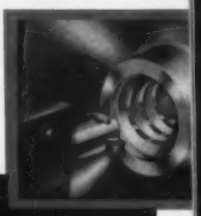
Harnischfeger produces a wide variety of industrial equipment requiring many types of threads in many different materials. The Cri-Dan technique was investigated as a possible means of reducing time and tooling costs of conventional methods. As a result, a Gisholt Cri-Dan E Automatic Threading Lathe was installed to handle a group of power hoist parts. Work included external threading on 15 different pinion shafts and worms and internal, 2-start threading on 8 different gear blanks.

The savings obtained on the 10″ steel gear blank setup shown are typical. It requires a .250″ deep, 1″ lead, 2-start Acme thread for a length of 2⅛″ in the 2″ bore. Brinell hardness is 269-302. Five taps were previously used, requiring 37 minutes to complete the thread. On the Cri-Dan E, work is chucked once . . . in a 12″ 3-jaw air chuck. The automatic cycle is started and the single-point tool completes the 2-start thread in 100 passes. Tool infeed diminishes on the last 6 passes providing a 125 micro-inch RMS finish. Floor-to-floor time is only 9 minutes.

Cri-Dan technique saves 30 minutes on this part. Tool costs and setup times have been reduced and a better quality thread and finish is obtained. Time savings average 60% on all parts handled.

For information on Cri-Dan E, circle No. 751 on inquiry card.

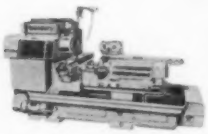
Close-up of 2-start thread and tooling. ▶



Single-point tool produces two-start thread in only 9 minutes f.t.f. compared to 37 minutes by previous methods. Inexpensive tooling, fast setup and versatility to handle all types of threads make the CRI-DAN pay off in any shop . . . large or small. ▼

AUTOMATICS DOUBLE PRODUCTIVITY...CUT TIME 65% AT BODINE ELECTRIC

. . . Six automatics replace 8 manual turret lathes, handle increased production . . .



How much could you save if you had Automatic Ram Turret Lathes in your shop? The results obtained by Bodine Electric, Chicago, Ill., provide some revealing answers to this question.

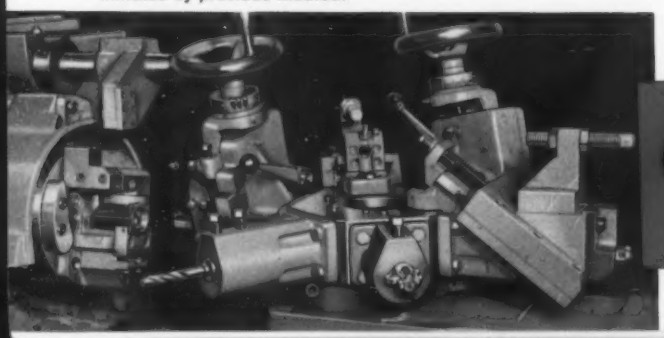
Bodine Electric is a well-known manufacturer of fractional h.p. motors. Components, such as worm gear housings, end shields, gear blanks, and gear shafts, were being machined on hand operated turret lathes. Analysis showed that greater efficiency was needed to keep costs in line, maintain the profit ratio and meet an anticipated production increase.

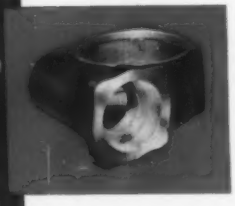
Various automatic lathes were evaluated. The Gisholt MASTERLINE Automatic Ram Turret Lathe was selected as the machine that would best meet their needs.

Here are the results of this important decision. Six machines, purchased over a period of time, do work previously done on 8 manual turret lathes and handle the increased production too . . . now over 360,000 units a year. Based on previous methods, floor space requirements were cut in half. The new Gisholt Automatic Rams gave them the capacity and versatility of a turret lathe with a fast automatic cycle, reducing operator effort to loading, starting the cycle and unloading. On bar work even less is required. Each operator handles two machines doubling individual productivity. Standard tools, already available could be used. Except for programming the cycle, setup methods were unchanged. Setup times were almost as low as for manual turret lathes.

Machining time was cut an average of 65% on *all* parts handled. Uniform quality, longer tool life and consistent production rates were other plus factors . . . with each automatic ram costing less than 1½ times the initial cost of a manual turret lathe!

Automatic Ram Turret Lathe tooled to machine flange end of worm gear housing.
Fixture adjusts for various sizes. Cycle includes use of multi-diameter cutter, drill, and automatic slide tools that quickly adjust for other sizes. Reverse feed provides close tolerance, fine finish needed. Time . . . only 1.3 minutes f.t.f. compared to 3 minutes by previous method.



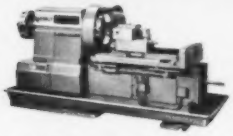


Six automatics do the work of 8 manual lathes and meet increased production requirements. Each operator handles two machines. Time cuts average 65% on all work handled. Fast setup and automatic cycle up profits on small lots or long runs.

For information on AR, circle No. 752 on inquiry card.

PRE-SET TOOLS SIMPLIFY GROOVING FOR CHICAGO PNEUMATIC TOOL COMPANY

. . . One basic setup covers three operations on wide range of work



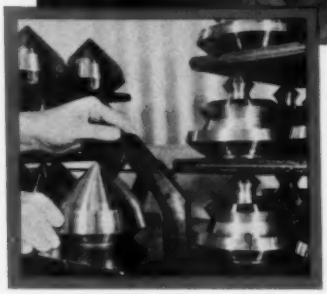
If deep grooving is one of your production problems, you'll want to study this setup. It shows how Chicago Pneumatic Tool Co.'s Oil Tool Div., Fort Worth, Texas, uses pre-set tooling and Simplimatic versatility to cut costs.

Workpieces are AISI 4815 steel oil well cutter bit forgings. Over 12 different sizes, from 5⅜″ to 12¼″ are produced. Previous blanking operations are handled on Gisholt No. 12 Automatics. Grooving work, on the three different cutter types made from each size blank is done on Gisholt Simplimatics.

Tooling is designed for fast changeover. Four sets of special chuck jaws handle all the part sizes. Tool bits are bolted in milled slots on spacer plates and pre-set in the tool room for each part type and size. These are quickly mounted on the slide tops as needed.

On the grooving setup shown, speed is 284 RPM . . . feed is .0045″. Both slides operate at the same time, completing the operation in one pass. Although material removal approaches 15-20%, time is only 2.5 minutes, f.t.f.

The Simplimatic was selected because it offered a large platen, upon which standard independent slides could be permanently mounted to cover the entire work range. The slides have swivel bases for speedy angular adjustment. Slide tops have micrometer adjustment, in and out, to minimize tool overhang. This provides rigid tool support for maximum metal removal using a 60 HP motor and long tool life (over 250 parts per grind). Both slides operate simultaneously, keeping cycle time at a minimum.



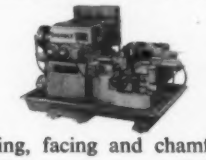
Basic setup handles grooving operations on cutter bit forgings from 5⅜″ to 12¼″. Pre-set tools on riser plates speed changeover. Gulfcut H.D. Soluble Oil Coolant reduces maintenance costs, combines with rigid tooling to provide finer finish, longer tool life and maintain .005″ tolerance on cone heights and groove depths.

Simplimatic offers capacity and versatility for wide work range . . . power and rigidity for maximum metal removal and minimum machining times. Pre-set tools cut changeover time . . .increase productivity.

For information on Simplimatic, circle No. 753 on inquiry card.

HOW TO SPEED SPHERICAL TURNING OF BALL VALVE PARTS

. . . Generating head on No. 12 handles over 30 different sizes . . .



Here's a real time-saving setup for generating spherical diameters. Shown on a Gisholt No. 12 Automatic Chucking Lathe, it combines spherical turning, blending, facing and chamfering into one fast, automatic operation.

A wide range of ball valve parts is handled by a spherical generating head on the rear independent slide. Sizes start at ¾″. The generating tool holder has micrometer adjustment for up to 5″ diameter work.

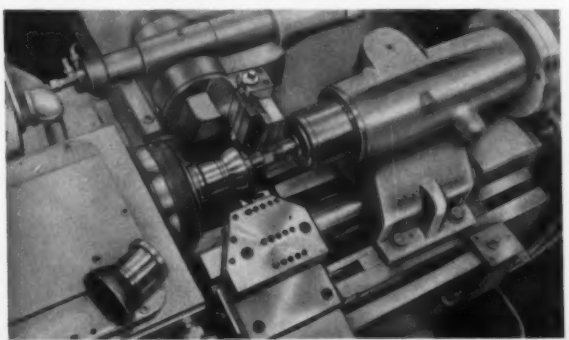
Representative parts showing variety of spherical surfaces machined with this setup. Note that parts have both smooth and threaded bores. The 2″ ball at far left is completed at 390 SFM in only .8 minutes f.t.f.

Tooling is designed for quick changeover. An air operated expanding mandrel and a threaded draw bar fixture were supplied to handle parts with smooth or threaded bores. Expansion sleeves, stop collars and drawbar extensions compensate for different lengths and bore diameters. An open-type tool block on the front carriage permits quick adjustment of replacement of other tools.

This is the sequence of the part shown in the illustration. It is held on an expanding mandrel with tailstock support. The 3.500″ spherical diameter is generated at .006″ feed, 390 SFM. An 80 micro-inch RMS finish is obtained. At the same time, front carriage tools blend at the base of the ball, face to length and chamfer. Time . . . only 1.3 minutes f.t.f. . . . compared to over 3 minutes by previous methods.

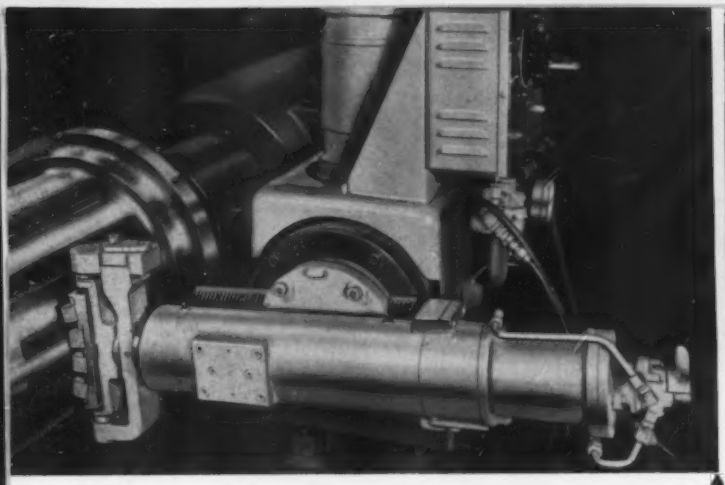
A spherical generating head can also be supplied for both rough and finish passes during the automatic cycle.

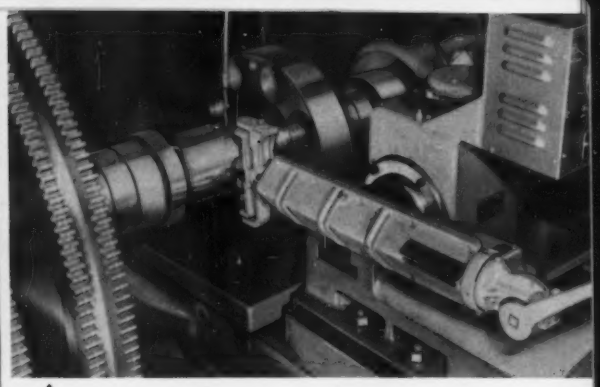
Rough part at left and finished part held on expanding mandrel. The 3.500″ spherical diameter is generated while front tools blend, face to length and chamfer. Time . . . only 1.3 minutes f.t.f.



Spherical generating head turns O.D.'s up to 5″ . . . meets close tolerance, fine finish requirements. Fast automatic cycle on No. 12 cuts machining time over 50%.

For information on No. 12, circle No. 754 on inquiry card.





▲ Model 62 Attachment used in Small Turbine Department saves $644 a year on labor costs alone! With traverse provided by tool post carriage, it handles any length within capacity of lathe.

▲ Model 73 Attachment used in Large and Medium Turbine Department handles diameters to 60″. Saves 7 hours on large journals . . . provides 5 micro-inch RMS finish.

WESTINGHOUSE CUTS 7 HOURS ON ROTOR JOURNALS WITH SUPERFINISH

. . . Low cost attachments eliminate grinding, provide better surfaces in less time . . .

Looking for ways to reduce finishing costs? These setups, at Westinghouse Steam Division, Lester Plant, South Philadelphia, Pa., show how you can do it with Superfinish.

Here, low-cost Superfinish Attachments are used for journals on large, medium and small turbine rotors. The attachments are portable with adapter plates that permit mounting on the tool post of any lathe. The rotors are held between centers. Longitudinal feed is provided by the tool post carriage.

Previously, rotor journals were turned .030″ oversize and ground. The best finish obtainable was 15 to 20 micro-inches RMS. Now, journals are turned .003″-.005″ oversize, then Superfinished to 5 micro-inches RMS.

Savings? Grinding of large journals used to take 8 hours . . . Superfinish takes only 1 hour. The Superfinish Attachments handle new rotors and also refinish other journals damaged in service without having to return the spindles to the factory. Cost analysis showed that one attachment in the Small Turbine Department saved $644 a year on labor costs alone . . . a 30.4% return on the original investment!

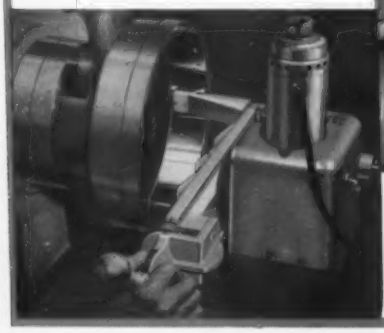
Superfinish saves time, provides better surface. Eliminates peaks...leaves plateaus and valleys for greater bearing area. Corrects part geometry...does not change surface hardness ...assures longer service life.

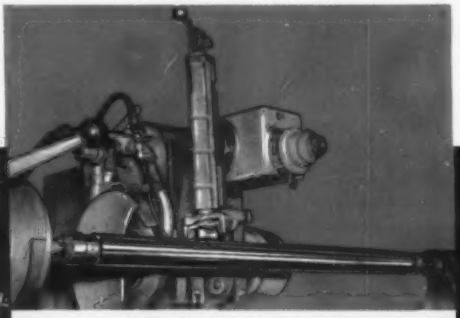
For information on Superfinish, circle No. 755 on inquiry card.

MORE JOBS

. . . Proof that Gisholt MASTERLINE Superfinishing Attachments can be used to advantage in your own operations.

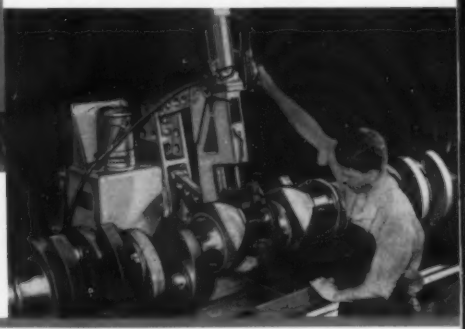
Off-set stoneholders are used for straight or tapered internal work. Model 60 Attachment Superfinishes air cylinder bore in only 3½ minutes. Ground surface is reduced from 30 to 5 micro-inches RMS.





Mounted on a grinder, Model 62 Attachment combines operations on pump piston rods. Parts are ground to size, the grinding wheel retracted and the attachment used to expose true base metal and provide a smoother, 5 micro-inch RMS finish.

Previously, main, pin and journal bearings were chrome plated .015″ oversize before finish grinding. Model 73 Attachment with latch-on follower-arm handles all surfaces. Superfinish required chrome plating only .002″ oversize saving $15 per surface on chrome plating alone!



GISHOLT

MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

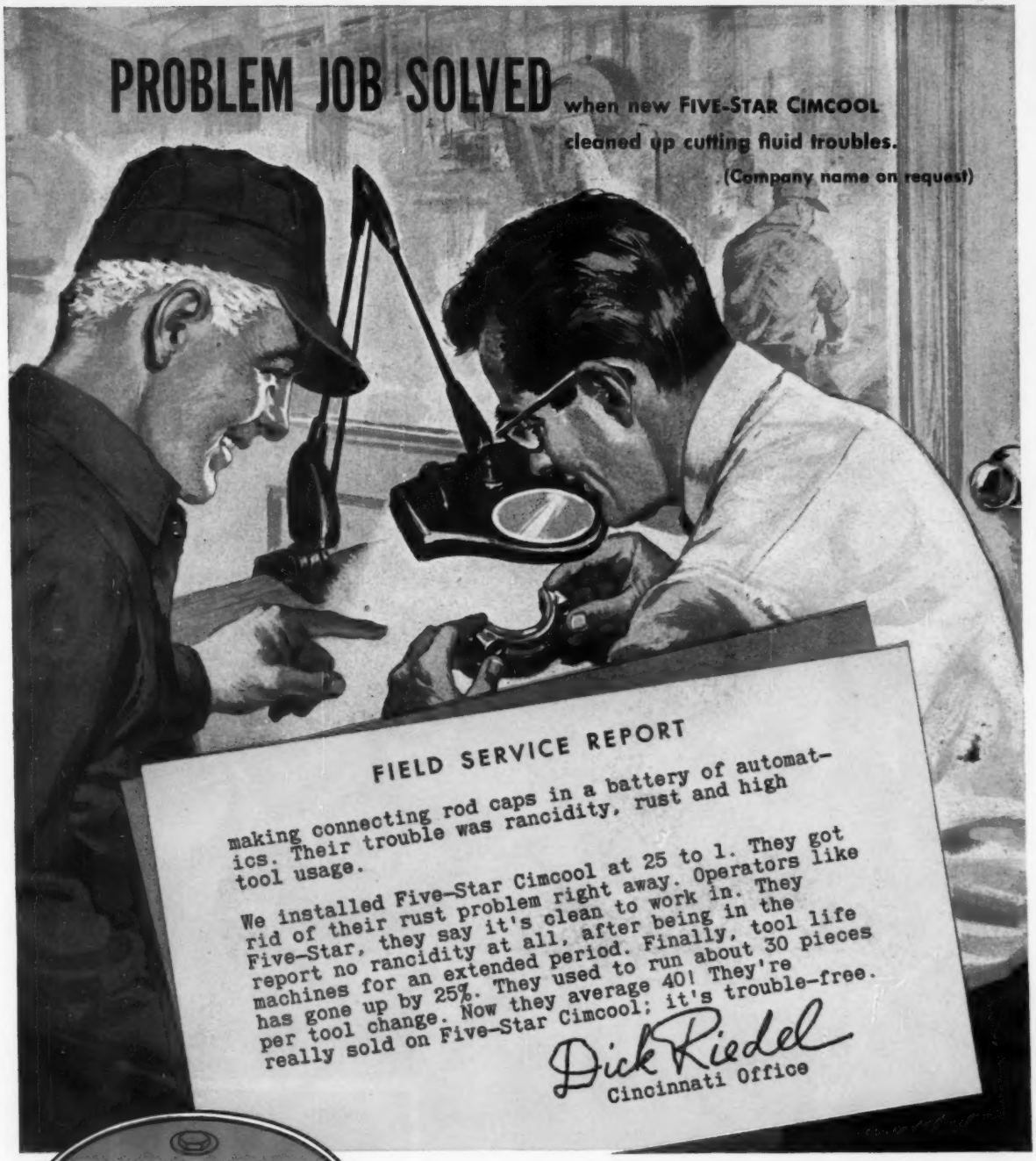
The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

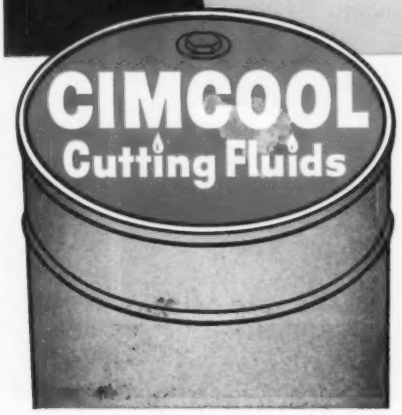
No. 5-661
800

Turret Lathes • Automatic Lathes • Balancers • Superfinishers

Threading Lathes • Packaging Machines • Masterglas Molded Plastic Products

Printed in U.S.A.





FOR 100% OF ALL METAL CUTTING JOBS

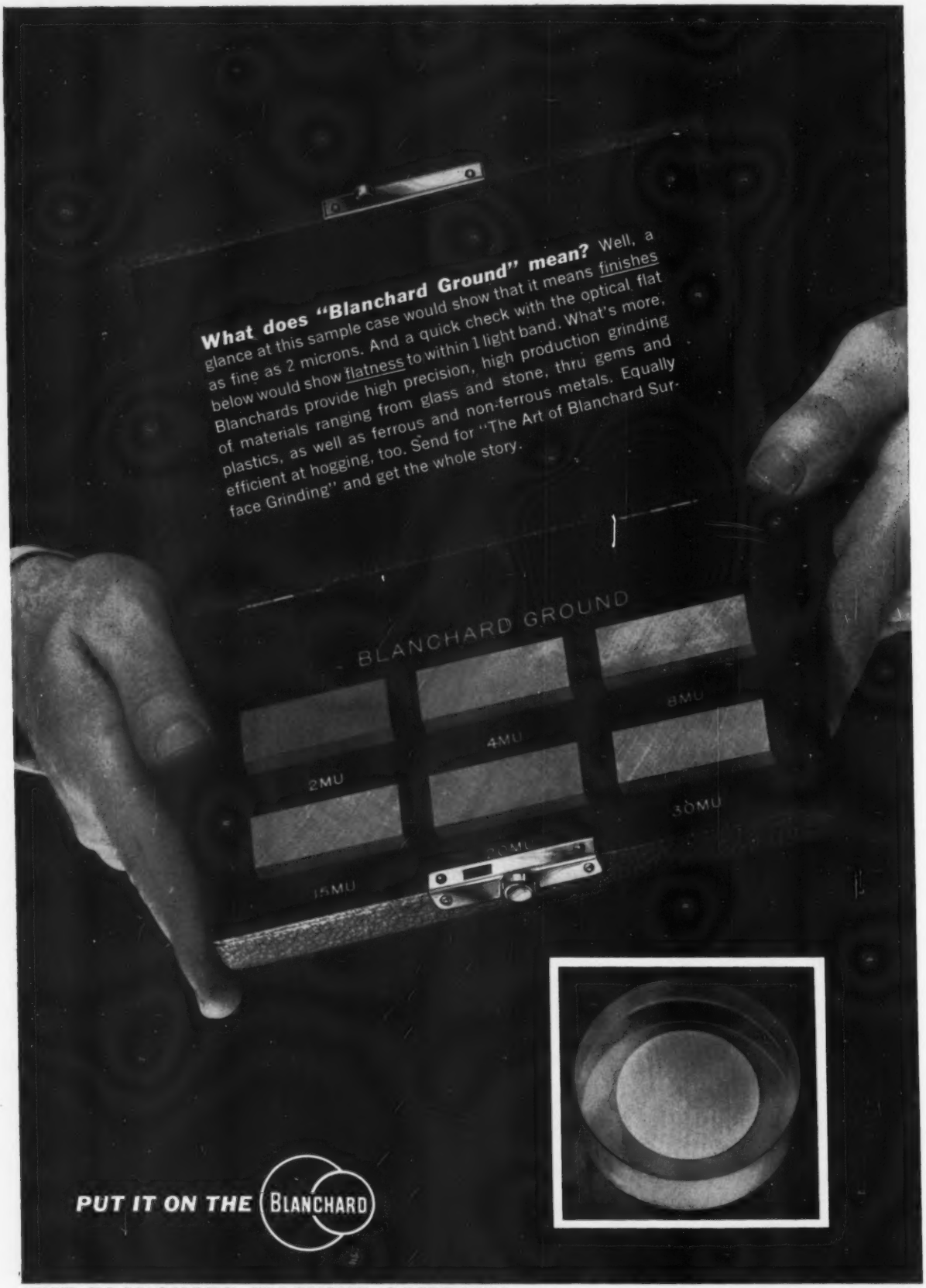
Production-Proved products of The Cincinnati Milling Machine Co.

FIVE-STAR CIMCOOL—Newest in the industry-proven line of CIMCOOL° Cutting Fluids.
CIMPERIAL° — Heavy duty replacement for cutting oils in those low-speed tough jobs.
CIMPLUS — The transparent grinding fluid which provides exceptional rust control.
CIMCUT Concentrates (AA, NC, SS) — For every job requiring an oil-base cutting fluid.
ALSO—CIMCOOL Tapping Compound—CIMCOOL Bactericide—CIMCOOL Machine Cleaner.

For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

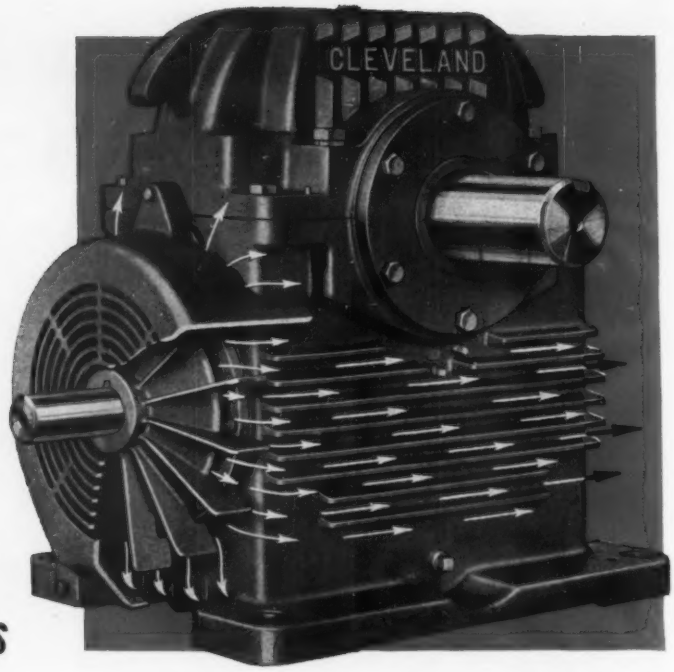
°Trade Marks Reg. U.S. Pat. Off.

What does "Blanchard Ground" mean? Well, a glance at this sample case would show that it means finishes as fine as 2 microns. And a quick check with the optical flat below would show flatness to within 1 light band. What's more, Blanchards provide high precision, high production grinding of materials ranging from glass and stone, thru gems and plastics, as well as ferrous and non-ferrous metals. Equally efficient at hogging, too. Send for "The Art of Blanchard Surface Grinding" and get the whole story.



PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY 64 State Street, Cambridge 39, Massachusetts



Fan cooling for Increased HP Capacity is Not New... *to users of Cleveland Speed Reducers*

As far back as 1944, Cleveland Speedaire Worm Gear Reducers (shown in both the announcement ad and cutaway photo below) were providing industry twice the load carrying capacity then available from standard worm gear units of equal frame size. Even then, it was *fan cooling* that did the trick—because fan cooling was and still is the most practical method of heat dissipation.

On the new, higher horsepower Cleveland's (shown in top cutaway photo), a small, specially designed fan—equally effective in either direction of rotation—is located on the worm shaft's input side. Fan size and design permit a smooth, more effective flow of air beneath, above, and around all sides of the reducer.

Mounting the cooling fan on the worm shaft INPUT end is a very definite Cleveland advantage for when the fan is mounted on the *opposite* side, a second oil seal is needed. This results in additional friction loss due to seal drag—and is another point where oil leakage could occur.

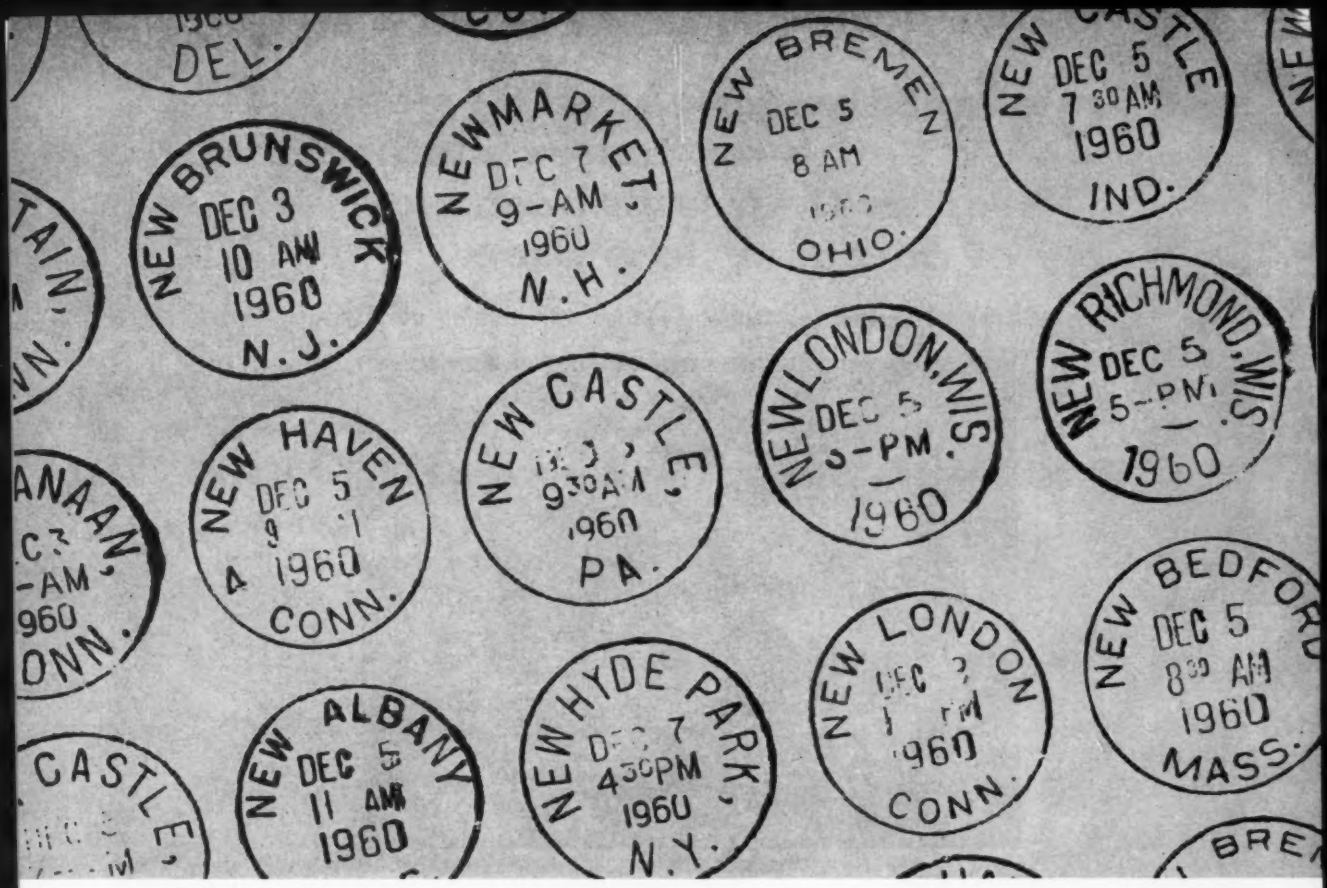
Remember, it was Cleveland design engineers who pioneered both fan cooling and centrifugal casting of bronze gears—and after sixteen years of rugged field usage in all types of industrial plants, have now incorporated these features in all units (from 3 to 12-inch centers) of the new standard Cleveland Speed Reducer line.

Get the story of these new speed reducers from your Cleveland representative, or write today for free 36-page illustrated Bulletin No. 410 that contains complete engineering information. Either way, you will get the answer to improved speed transmission—at savings of 50% or more on per horsepower cost!

A 1944 CLEVELAND AD
"Announcing A Fan-Cooled Worm Gear Speed Reducer . . . SPEEDAIRE."

CLEVELAND
Worm Gear
Speed Reducers

Cleveland Worm & Gear Division
Eaton Manufacturing Company
3270 East 80th Street • Cleveland 4, Ohio



Wherever your tooling operation is located... here's a low-cost answer to common headaches

From New Haven to New Castle and points West . . . wherever toolmen want a simplified, low-cost answer to many tooling problems . . . Carpenter STENTOR (Oil-Hard) enjoys tremendous popularity. Here's why: STENTOR is one die steel you can live with. Its sound, uncomplicated analysis . . . free from hard-to-machine alloys . . . saves as much as 10% in machining costs. STENTOR is easy to heat treat . . . hardens at a low temperature of 1425°F to 1525°F. You'll like its freedom from decarb because STENTOR holds size so accurately many people do not even grind STENTOR tools after hardening. Little wonder it is the most widely used of all die steels in the Carpenter Matched Set of twelve! Put through an order now—you can get prompt delivery from your nearest Carpenter Service-Center.

Carpenter steel

You can do it ***consistently*** better with Carpenter Tool and Die Steels

The Carpenter Steel Company, Main Office and Mills, Reading, Pa.
Alloy Tube Division, Union, N. J.
Webb Wire Division, New Brunswick, N. J.
Carpenter Steel of New England, Inc., Bridgeport, Conn.

Dial the **Monarch** Series 62 Lathe for **faster metal removal,** greater **accuracy** of output in **less time**

...and thereby substantially reduce unit turning costs!

The Monarch Series 62 Dyna-Shift gives a greater ratio of metal removing hours to work hours than *any* less modernly designed machine. Such performance is the only true measure of lathe value.

It's a commonly accepted fact that the most efficient cutting condition results from the maintenance of correct surface speed. That's easier said than done. Who makes the calculations? Will they be accurate? Will the speed be changed for each diameter changed? And how about the time required to do all this?

You dial for production on the Series 62. It's totally unnecessary for the operator to calculate spindle speed (R.P.M.) from the diameter of the work and the recommended surface cutting speed (S.F.P.M.).

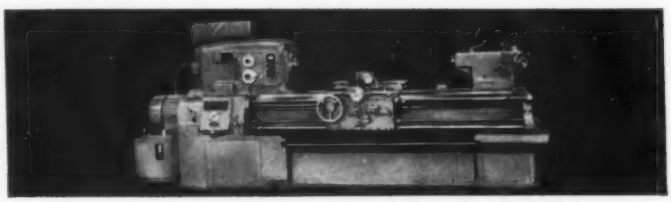
Once the work piece diameter and surface speed are set, the headstock automatically and instantaneously calculates and sets up the correct spindle speed.

Preselection saves further time. This device virtually thinks ahead to preselect speed changes for you on succeeding diameters while the machine is taking a cut. Result is that it's easier for the operator to use the right speed than it has been for him, in the past, to use the wrong speed. The real pay-off is increased productiveness, less effort expended and prolonged tool life.

Every feature of the Series 62 matches the Dyna-Shift headstock for all-around superior performance. It has weight, reserve power, built-in precision, simplified maintenance. The famous Monarch "Air-Gage Tracer" may be applied. A vast array of accessory equipment is available.

Think of the Series 62 as a lathe that thrives on hard, exacting usage. Watch the chips peel off on heavy cuts! Get precision finish such as you may never have expected of a lathe! Don't hesitate to tackle jobs which call for close limits! Turn high temperature alloys and many other materials with the harder TiC carbide and oxide tools!

When rising costs demand more parts on the floor per day . . . greater accuracy of output in less time: Dial 62 for production. Try 1508 which is the number of our new, profusely illustrated booklet. The MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO.



Monarch
TURNING MACHINES

ASK ABOUT THE MONARCH DEFERRED PAYMENT AND TOOL LEASE PLANS

IMPROVES RELIABILITY OF PRESS FITS . . . CUTS COSTS
. . . without A Penny Invested in Equipment!

Simply apply a few drops of LOCTITE Sealant to press fit assemblies. Look at these production assembly advantages:

- Greatly increases reliability of interference fits and other methods of metal-to-metal assembly.
- Requires no expensive equipment—the plastic bottle is the applicator. Can be used for automatic or mass application with simple "around-the-shop" parts.
- Increases allowable tolerances—reduces machining costs.
- Reduces materials costs—minimizes design requirements.
- Facilitates assembly of delicate parts—reduces danger of deformation.
- Facilitates proper concentric fit of mated parts in line-to-line fits—this liquid-turned-to-solid mates parts better than any metal-to-metal contact possible.

. . . and parts can be disassembled with standard tools and techniques.

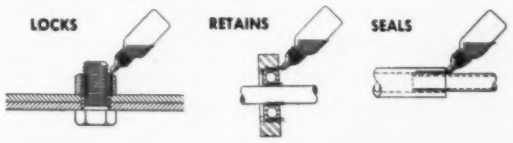
WHAT IS LOCTITE? LOCTITE Sealant is a penetrating liquid resin with low viscosity that hardens when confined between closely fitted metal surfaces. It "wicks in" between the most closely mated of matched precision surfaces and hardens into a strong, heat-, oil-, grease-, solvent- and vibration-resistant bond. LOCTITE completely fills the space between the surfaces . . . adds its sheer strength to that of the press fit. There are no solvents to evaporate —no catalyst to mix.

On the production assembly line and in other areas, too, the LOCTITE Method replaces and improves many different mechanical means of *locking—retaining—sealing.* LOCTITE Sealant has already brought these benefits and savings to such leading companies as:

Bendix Corporation	Norge Division, Borg-Warner
Consolidated Diesel Electric Corp.	Remington Rand Univac
The Maytag Company	Philco Corp.—Government & Industrial Div.
Westinghouse Electric Corp.	General Electric Company
General Dynamics Corporation, Electric Boat Division	Raytheon Mfg. Co.
Reeves Instrument Corporation	McDonnell Aircraft Corporation

Veeder Root, Inc.

Details on your particular application bring immediate response from our Application Engineering Dept. Or, better yet—make your own convincing test. Mail check for Test Kit No. 10-10 ($16.50 complete).



LOCTITE® SEALANT

American Sealants Company • 207 North Mountain Road
Hartford 11, Connecticut

You can turn a profit on a New Britain +GF+ Copying Lathe

Here's a birdseye view of a New Britain +GF+ Copying Lathe. It shows some important differences between this machine and conventional lathes with copying attachments. The point here is this—*the most effective use of the single-tool copy-turning principle can be made only with a machine designed from the ground up for this type of work.* The New Britain +GF+ is just such a machine. Notice the chip pan. It's big (it has to be) and located for easy removal of chips from the back of the machine. The design of the work area allows for unobstructed free-fall of chips out of the way and into the pan.

The New Britain +GF+ is massive and rugged, with plenty of power—up to 40 h.p., if you need it. It's simple to operate, quick to set up and change over. The single-point tool can be changed in one minute and it out-produces gang tooling setups in the bargain. Turning is controlled by either a template or a prototype. External and internal copying are accomplished in one set-up with special tooling.

The possibilities for short or long run chucked and between centers work on the +GF+ are wide and varied. Because the work is produced with good surface finish and dimensional accuracy, grinding can be reduced and, in some instances, eliminated. Large diameters are broken down economically by successive parallel cuts, automatically if desired, with optional two-cut or multi-cut recycling.

You've got to see one of these machines in action to fully understand the kind and quantity of work they are capable of producing. Contact your New Britain Representative for demonstration arrangements or write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

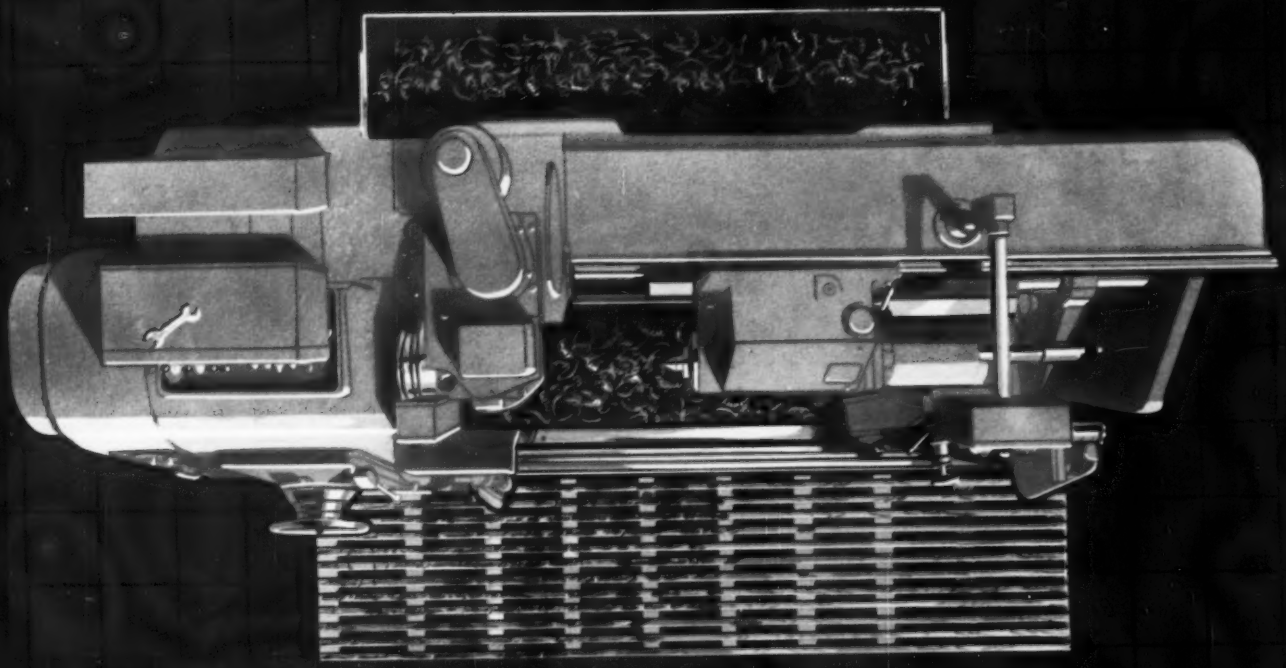
NEW BRITAIN • GRIDLEY MACHINE DIVISION

Unlimited tooling combinations with New Britain Bar Machines

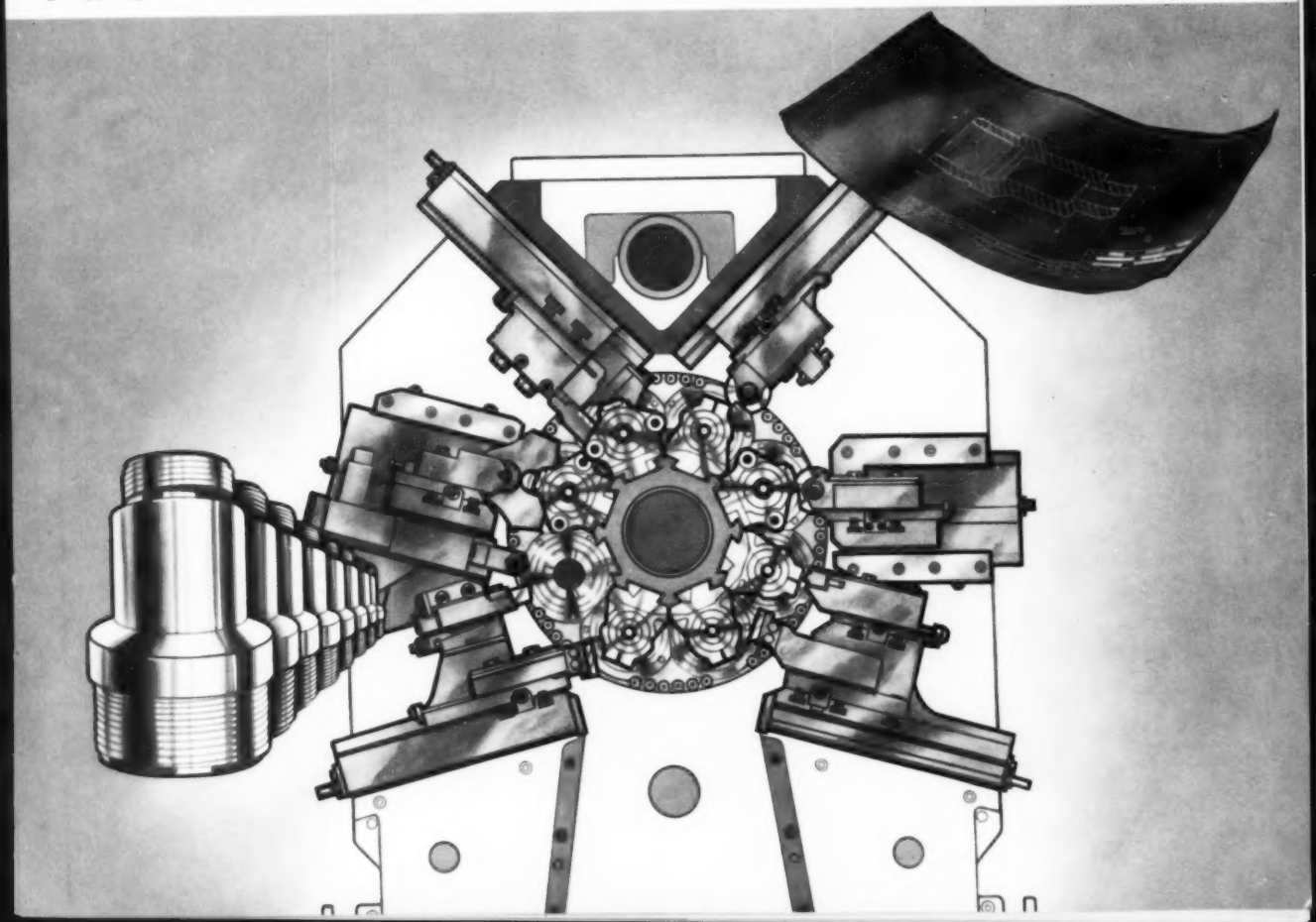
Nothing can out-date your operation quicker than better machines in the hands of a competitor. In the race to keep ahead on quality, price and delivery, nothing can put you out front faster than machines capable of consistently producing the highest quantity of finished pieces at the lowest possible cost. New Britain's new series of bar machines represents in every way the most advanced bar-turning units available. Each of the four-, six- and eight-spindle models has been redesigned, adding new features and improving older ones. Unlimited cross slide and end-working tool combinations, extremely fast operation (even on stainless) and a variety of models and features to choose from add up to some good reasons for incorporating New Britains into your replacement or production expansion plans.

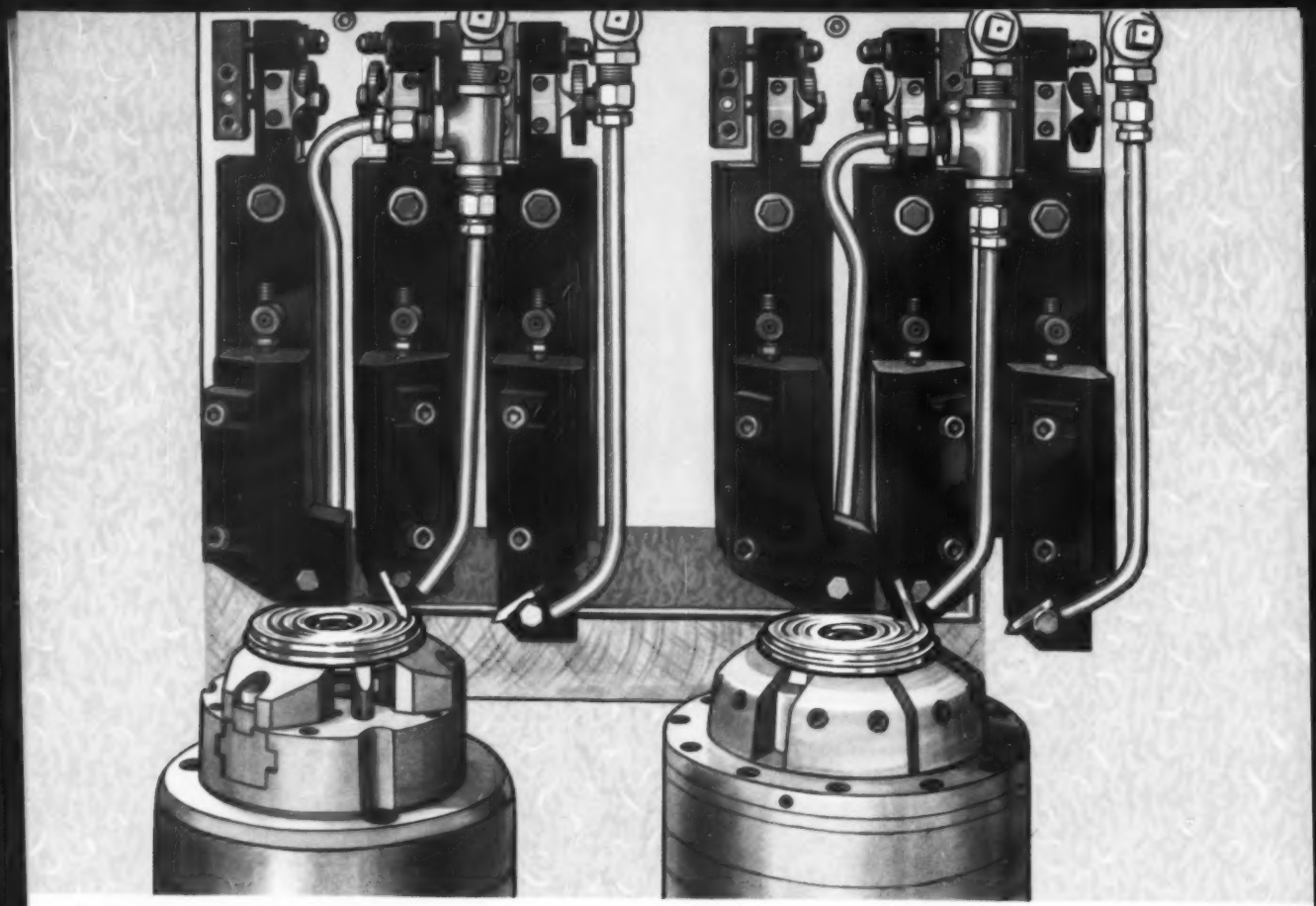
The eight-spindle model is the largest, most modern eight-spindle bar machine available. It has a stock capacity of up to 2⅝" and provides six independently-operated cross slides. As with all New Britain bar machines, the operations of the cross slides and end-working tool slide are disc-cam controlled for positive actuation, close tolerance machining and easy, rapid change-overs.

This is only a very small part of a story that is bound to interest you. The whole story and its significance in terms of your profits is available from your New Britain Representative. If you prefer, contact us directly at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

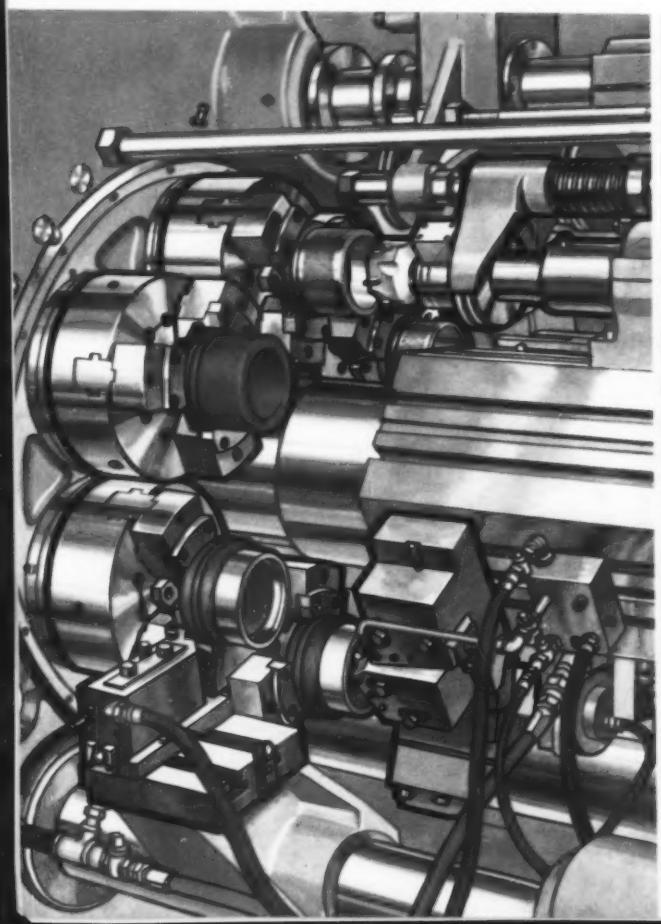


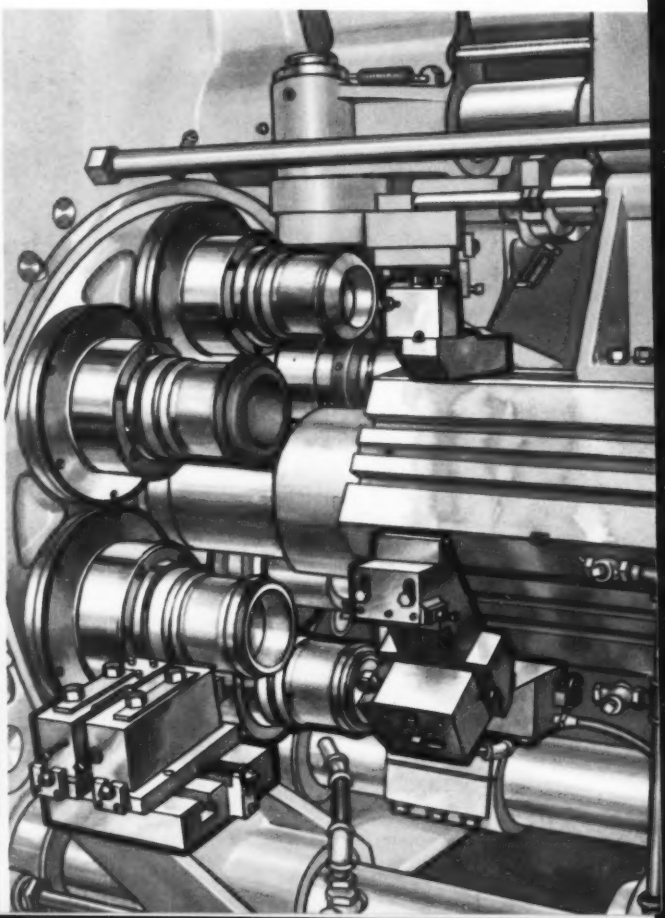
THE NEW BRITAIN MACHINE COMPANY





NEW BRITAIN · GRIDLEY MACHINE DIVISION





New Britain's new concept for contour turning and boring

Beyond a certain point, continued refinement of existing designs in machine tools ceases to make an appreciable contribution to performance. Thus in designing our New Series of Vertical Precision Boring Machines, we have incorporated several completely new design concepts to provide improved performance and greatly increase over-all usefulness.

For the first time machines of this type can be used as building block units. Their clean-sided design permits any number of self-contained machines, each with one or more spindles, to be arranged side by side and operated as a single unit. They also may be operated with equal efficiency as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine.

In order to take the fullest advantage of the precision inherent in cam control, long linkages between cams and slides have been eliminated. A pair of cams is mounted on a common shaft which is carried *within the vertical slide.* Since all slide actuating forces are contained in the vertical slide, both cams are directly adjacent to the slides they control and no outside forces are imposed on the slide ways. The result is maximum rigidity for heavy cuts coupled with extreme accuracy for close tolerance work.

This unique and eminently workable approach to contour turning and boring results in the highest order of accuracy on even the most complex pieces. Your New Britain Representative can give you details on the nine different models available in this series. For catalog material, write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

THE NEW BRITAIN MACHINE COMPANY

New Britain . . . still the best Chucker you can buy

We're not unhappy about the fact that for years, in many plants, the name New Britain has been synonymous with chuckers. New Britain Chuckers have turned out literally millions of pieces of work for practically every major industry in the world. This is less important to the prospective buyer of one of these machines, however, than the capabilities of these machines today. How do they stack up against other chuckers or even other types of machines capable of doing similar work? Pretty well, we think.

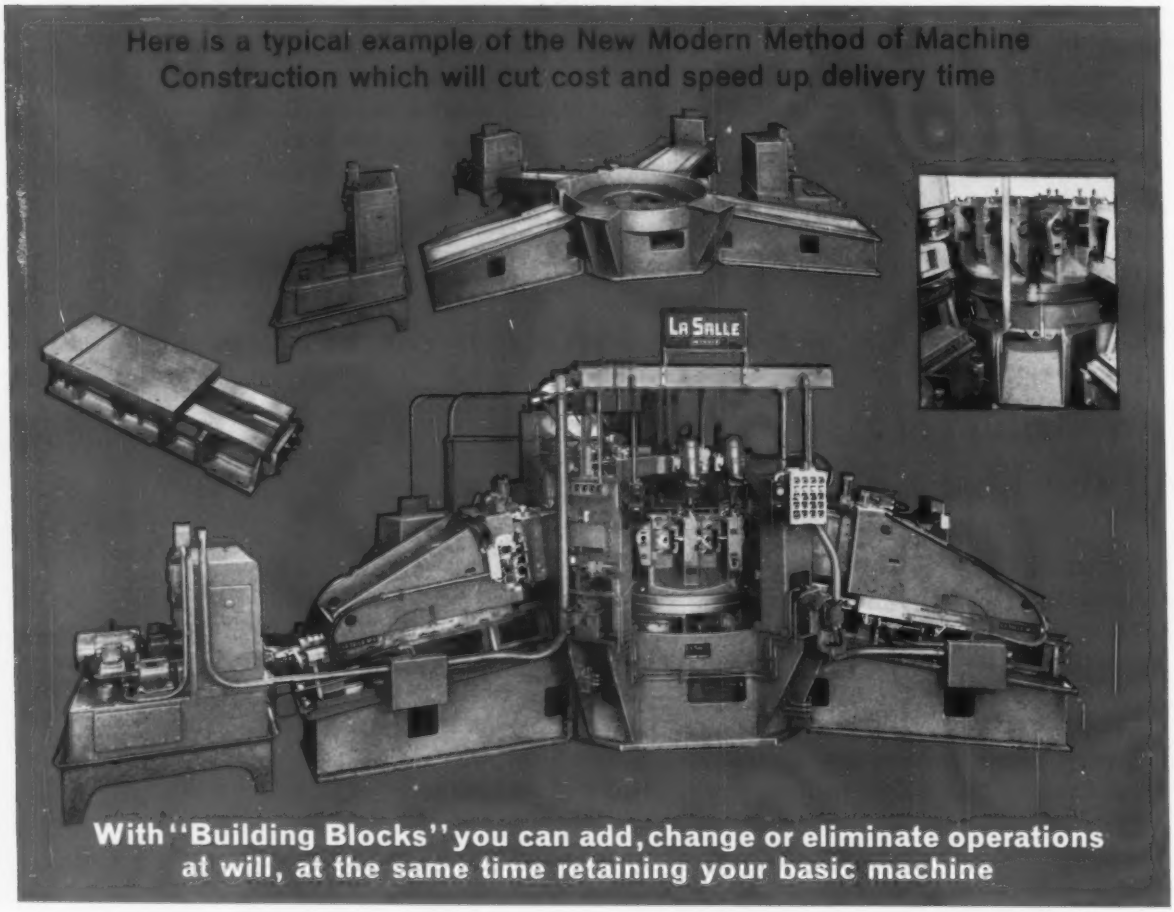
New Britain's open-end design still can't be beat for unlimited accessibility to the tooling area. This same wide-open feature makes it doubly more practical to adapt these machines to automatic loading and unloading.

The unusual combination of longitudinal and transverse forming motions is another unbeatable New Britain feature. The massive forming arms on New Britain Chuckers allow heavier cuts and cuts of much greater complexity. This ability to do more work can eliminate the need for second operation machines in many instances. For really complex work, two chuckers set up side by side, as shown here, each doing one side of the piece, can smooth the way for high production. Less complicated work can be set up to perform both sides of the same piece on a single machine.

These massive machines provide the tooling combinations, spindle speeds and power to perform the widest possible variety of work. Their basic design will stay new for years to come, continuing to provide profitable operation. You may know New Britain Chuckers, but you may not be fully aware of the improved series presently being offered. Why not call your New Britain Representative or contact us at The New Britain Machine Company, New Britain-Gridley Machine Division. New Britain, Connecticut.

HAVE YOUR AUTOMATION MACHINE TOOLS BUILT BY La Salle FROM STANDARD BUILDING BLOCKS

ELIMINATE duplicate engineering • AVOID premature obsolescence
ELIMINATE pattern costs and machining time



LaSalle—One of the Nations Larger machine tool builders has pioneered the way to a better Construction Method for all Machine Tools.

WRITE FOR BUILDING BLOCK CATALOG NO. 1.

La Salle machine tool, inc.

AUTOMATION ENGINEERS • SPECIAL MACHINE TOOLS

21535 Hoover Road Warren, Michigan

4-col. presses bristle with production-boosting features

KRW has done it again! This time, the 25-1000 ton KRW line of 4-column, single action hydraulic presses has been modernized to set a new pace over a broad work range.

Bristling with newness, these smooth-acting machines are built to outperform even KRW's highly regarded, prior designs in a wide variety of assignments: Blanking, forming, punching, trimming, drawing, extruding, briquetting, straightening, pressure clamping, laminating and bonding.

Already acclaimed "a marked success," KRW's latest version of the 4-column press boasts numerous features to improve quality and increase productivity: Of rugged, welded steel construction, the crown, bed and sliding platen provide maximum resistance to deflection. Align-bored to automatically controlled tolerances, the sliding platen is guided on ground and polished columns which are closely fitted into the crown and bed.

Easy to adjust, KRW hydraulic systems assure instant, complete press control. Compactly designed, the pumping unit can be mounted at the top of the press or furnished for floor installation.

Available with either up-acting or down-acting platens, KRW 4-Column Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling.

For detailed information and specifications, write for Bulletin 95-D. K. R. Wilson, Inc., 214 Main St., Arcade, N. Y.

KRW HYDRAULIC PRESSES

The Friden Flexowriter®: Machine Tool's Machine Tool

At the recent Machine Tool Exposition, approximately 80% of the numerically controlled tools on display featured 8-channel punched paper tape input.

The toolmakers have shown this overwhelming preference for punched paper tape for several reasons:

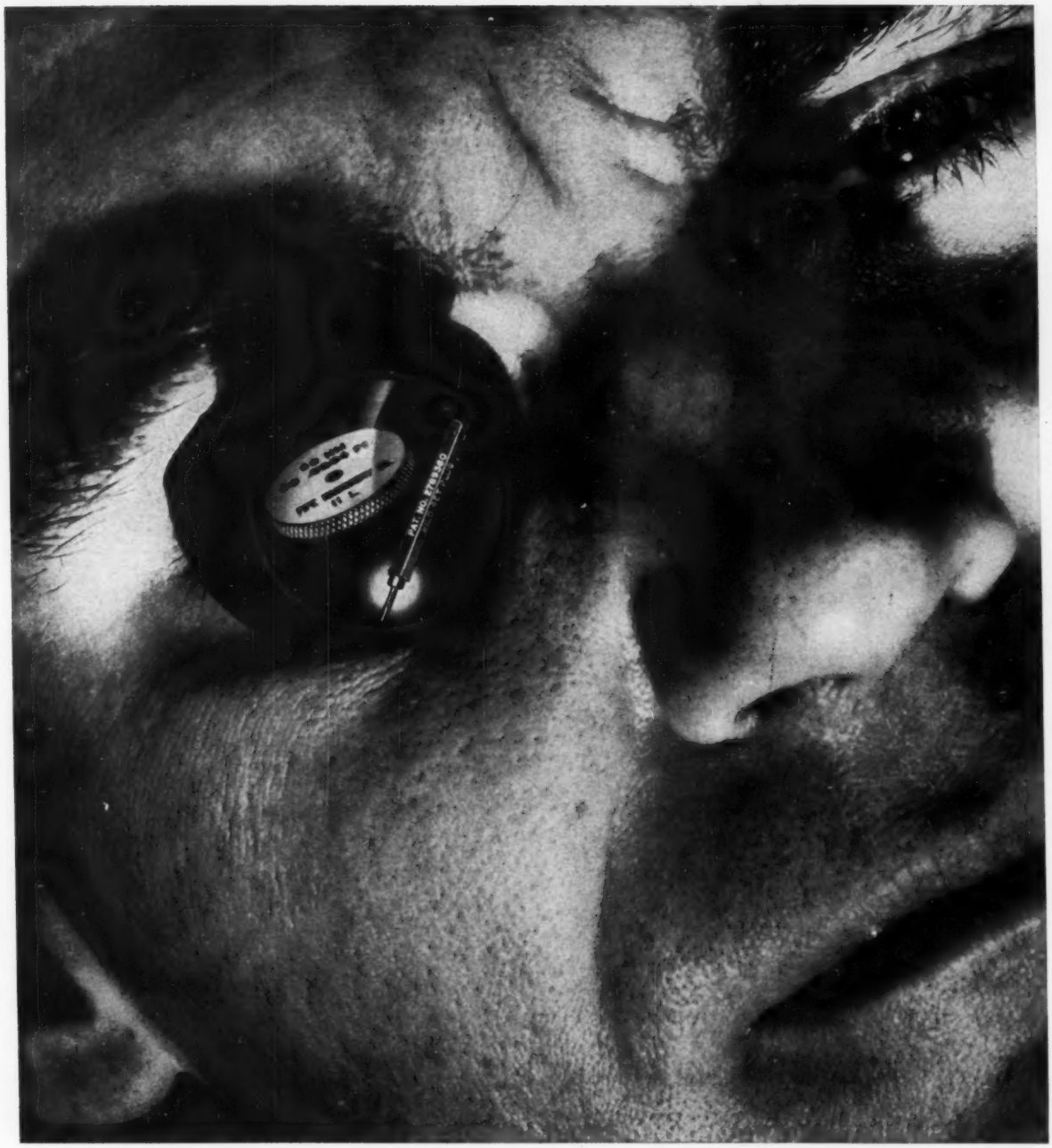
1) the tapes are easy to prepare,
2) the coding is visible,
3) tape can't get out of sequence,
4) tape is durable and unaffected by chance exposure to magnetic fields.

By standardizing on paper tape input for your numerically controlled tools, you get all the benefits listed above, plus one more: It's so much easier (and less expensive) when all of your numerically controlled tools can be programmed on one device. That device? The Friden NC-1 Flexowriter—the machine tool's machine tool.

THIS IS PRACTIMATION: Friden is the world leader in tape technology and the practical application of the automation it makes possible. For full information, call your local Friden Systems Representative. Or write: Friden, Inc., San Leandro, California.

Friden

Sales, Service and Instruction Throughout the U.S. and World



Take A Close Look At Pipe Machinery's Small Thread Gages

. . . here's real craftsmanship! Extremely troublesome to many gage manufacturers, fine pitch threads in small diameters have long been a specialty at Pipe Machinery.

Hard to see in detail without a glass, such miniatures as those pictured above are made with the same painstaking attention to detail, the same dedication to quality and accuracy that go into all of our other gage products.

You'll find it pays to look to Pipe Machinery for small thread plug and ring gages that meet your strictest specifications for precision. For further information write us on your company letterhead today.

THE PIPE MACHINERY COMPANY 29100 Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland

NEW *small-press versatility*

NEW *small-press productivity*

NEW HYDROLAIR!

... it's DOUBLE ACTING!

Like all other Hydrolairs®, this new 30-ton model is a full oil-hydraulic press without motors or pumps—operates directly from shop air line.

ECONOMICAL
COMPACT
VERSATILE
EASY TO OPERATE AND MAINTAIN
and, it's DOUBLE-ACTING!

Smoother, better performance on drawing and forming; greater productivity on plastics molding; greater versatility for development work and job shops; ideal for small-press users!

Ask your South Bend *Distributor about the new 30-ton DOUBLE-ACTING Hydrolair — and single-acting Hydrolairs in 50, 75 and 100-ton capacities.*

WRITE FOR COMPLETE INFORMATION

SOUTH BEND LATHE

SOUTH BEND LATHE, INC.
SOUTH BEND 22, IND.
A SUBSIDIARY OF AMERICAN STEEL FOUNDRIES

Builders of Lathes • Milling Machines • Shapers • Drill Presses • Pedestal Grinders

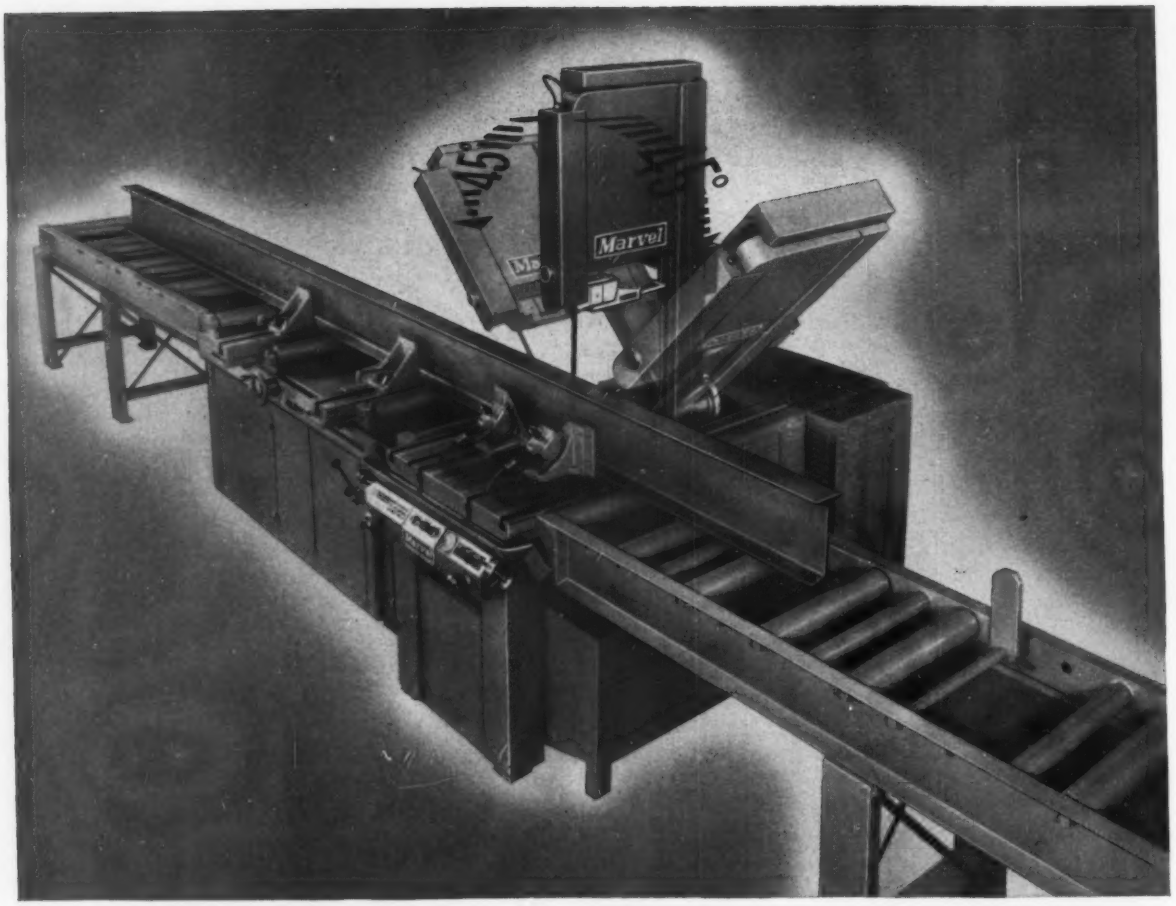
YOU'RE ON THE MONEY WITH **UNIVERSAL DRILL BUSHINGS**

222

In shop talk you're "on the money" with Universal drill bushings. You're "in the money" with savings, too. Universal drill bushings save tools because they have super finished bores, blended radii and 100% concentricity. They wear longer and are easier to change due to their knurled heads. All standard sizes and lengths available for immediate delivery.

Write today for new catalog showing the complete line of Universal quality products.

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 2, MICHIGAN



Tips Its Head To Cut Production Corners

Sawing 45° miters in any kind of material has always been a simple task for MARVEL Saws, but moving the work up automatically and making consecutive cuts on an angle was a problem, especially when the work was long and cumbersome.

This triple exposure photograph of a new MARVEL No. 81A All Hydraulic Heavy Duty Automatic Bar Feed Band Saw, illustrates how the upright head or column can be tipped 45° either right or left of vertical to make angle or miter cuts. The work is held stationary while the column, which carries the blade, is fed forward, meeting the work squarely to insure accurate cutting. After the cut is completed, the work is automatically moved up and measured, and another cut made.

Automatic miter cutting is just one of many exclusive universal features of these band saws. Designed to utilize every advantage of high speed steel band blades, MARVEL No. 81 Series Band Saws can handle almost any conceivable sawing job—from the smallest, most delicate work, up to 18" x 20" shapes.

Only the MARVEL No. 81 Band Saws have the "SURE-LINE" Automatic Accuracy Control (basic patent applied for) which literally steers a blade to make a straight cut. This unit extends usable blade life as much as 50%.

MARVEL No. 81 Series Band Saws are proving themselves daily, as the most versatile machine tools in production metalworking plants.

For complete details, or a demonstration of MARVEL Sawing Equipment, write: Armstrong-Blum Manufacturing Co., 5700 W. Bloomingdale Ave., Chicago 39, Ill.

MARVEL Metal Cutting SAWS
Better Machines-Better Blades

General Electric announces

Carb-O-Lock

the single, most important advance in the whole history of disposable tooling!

Revolutionary... toolholder-insert combination cuts tool costs up to 40%

New
Carb
inse
offe
30%
when

40%
edge

Asto
in d
It's

th

Revolutionary... toolholder-insert combination cuts tool costs up to 40%

ew
arb-O-Lock toolholder-
sert combination
ffers unheard of savings...
0% and more
hen you buy it!

0% and more per cutting
dge when you use it!

stonishingly simple
design; so easy to use.
's new...it's Carb-O-Lock!

CARBOLOY®
CEMENTED CARBIDES

Think of it! Now you can cut your disposable tooling costs by up to 40%! This revolutionary Carb-O-Lock toolholder-insert combination costs 30% less to buy than ordinary toolholders . . . costs 40% less to use. You save and keep on saving, because savings are designed right into the new Carb-O-Lock toolholder-insert combination.

The Carb-O-Lock is truly unique in toolholder design. *Simplicity* is the key! Carb-O-Lock employs just *three* parts (not including insert) — compared with up to 12 parts in other toolholders. Using a cam-action locking principle, the Carb-O-Lock toolholder makes insert changing and indexing a breeze . . . easy as one, two, three! And the streamlined design of this revolutionary toolholder lets you bring it closer to the work, with unrestricted chip flow. No clamps . . . no "clubheads" . . . no complex mechanisms.

HANDLES MOST OF THE FOLLOWING MACHINING JOBS

Carb-O-Lock toolholders are available right now in toolholder shank sizes from ½" square to 2" square for square inserts and ½" to 1½" on toolholders for triangular inserts to be *used profitably in your shop.* The specially processed close-tolerance, disposable inserts have been developed in Carboloy® Grade 883 for machining cast iron as well as many operations on the following materials: high-temperature alloys, type 300 stainless steel, brass, and bronze.

Look over the features on the next page. See just how this brand new toolholder-insert combination can mean big savings in *your* metalcutting operation. Phone your Authorized Carboloy Distributor and place your order. Then use Carb-O-Lock — designed to bring you even *better profits through better tooling.*

Great! . . . *revolutionary!*

Metallurgical Products Department of General Electric Company, 11173 E. 8 Mile Avenue, Detroit 32, Michigan.

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMOND • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

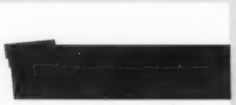
Simplicity is the key

Check these features...

The all-new Carb-O-Lock toolholder-insert combination was developed for just one reason: To reduce your present machining costs. Can it? Yes. Here's why . . . and how.

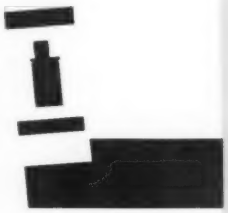
LOW, LOW SILHOUETTE

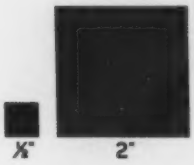
No "clubheads," clamps, or screws sticking up to take up space or interfere with the chip flow – not even on the smallest size (½" square shank) Carb-O-Lock. Nothing to wash off or wear away.



FEWER PARTS

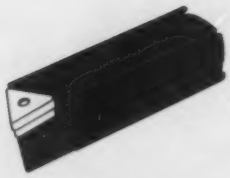
Carb-O-Lock employs just three parts (not including insert): Hard-tough cam pin, Carboloy carbide seat, heat-treated shank. Results—decreased parts inventory, absolute minimum possibility of part failure, greatly reduced downtime, lower replacement-part cost, and lower over-all cost.





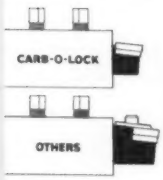
PICK THE ONE YOU NEED

Carb-O-Lock comes in 15 styles, 124 sizes for triangular and square inserts. Shank sizes from ½" square (use it to replace your brazed tooling, too!) to 2" square.



LOOK . . . NO POCKET!

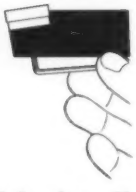
Carb-O-Lock gives you larger end-cutting edge angle because no pocket is needed to retain insert. Can often be used on many tracer applications with limitations on plunge angle.



REDUCED OVERHANG

Reduces space requirements for locking mechanism—less deflection and vibration. This means less insert chipping and breaking, for longer, more consistent tool life.

TOUGHER

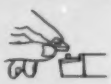


The cam pin in the Carb-O-Lock is a high-alloy bearing steel. Has not broken under the severest use. Cam action forces insert against shank, so insert stays locked in place until *you* loosen it. Cam pin is adjusted from underneath. Self-cleaning, self-locating wrench socket . . . never clogs . . . makes indexing and changing of inserts a breeze.

ONE-TWO-THREE INDEXING

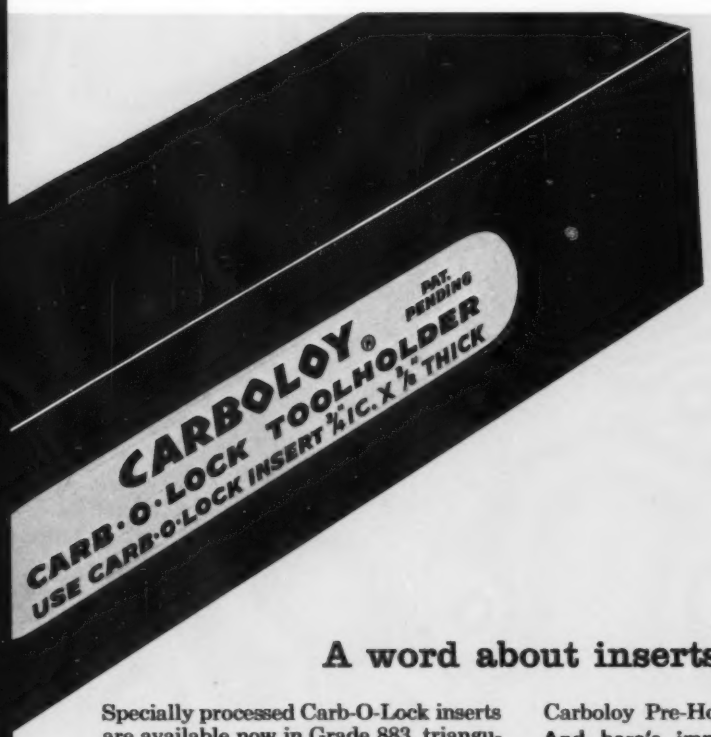
THIS ✓ IS ALL YOU NEED. JUST TWIST,

REPLACE OR INDEX INSERT,



TWIST.

to the new Carb-O-Lock



NOTE TO SPECIALIZED SHOPS

We can't overstress the importance of the Carb-O-Lock toolholder-insert combination to those who are *not* using carbide disposable tooling in their machining operations. Up until now, if you wanted to use disposable-insert carbide tooling, the cost of the toolholders may have represented an investment that was larger than you cared to make.

Not so now. No longer must you settle for second best. Because the new Carb-O-Lock fits easily into your tooling budget. Now you can have the quality of carbide tooling at the lowest cost ever – even lower than your present tooling. And the broad range and sizes give you the flexibility that makes carbide tooling on small-lot jobs economical. Check into it . . . and see!

A word about inserts

Specially processed Carb-O-Lock inserts are available now in Grade 883, triangular and square. These inserts are held to tolerances of ± .002" on ¼" I.C. to ± .004" on the 1" Sq.. They cost 40% less than some precision-ground (± .001") inserts.

These inserts have cutting edges composed of whole carbide crystals which are stress free, and notch free like Carboloy Pre-Honed inserts.

And here's important news. Carb-O-Lock inserts are designed to fit most square or triangular negative rake toolholders you may now be using. This means that while you are changing your operation over to Carb-O-Lock, you can begin by buying the new inserts. Then, as you replace your present toolholders, just order the new Carb-O-Lock. Simple.

. . . and about packaging

Carb-O-Lock inserts come skin-packed on a color-coded card with complete identification which fits in a standard 3" x 5" file drawer for easier storage and inventory, faster identification, simpler handling.

Carb-O-Lock Grade 883 inserts are skin-packed — five or ten to a card depending on size. This means: Easier inventorying • Chipping is eliminated • No surface contamination from handling • Color-coded grade identification • Cards fit standard-size filing cabinet.

Your Authorized Carboloy Distributor can supply you with the new Carb-O-Lock inserts in Grade 883 now. Call him today.

CARBOLOY®
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMOND • MAGNETIC MATERIALS
THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

ACT NOW!
YOUR SAVINGS BEGIN WITH CARB-O-LOCK!

THE MOST COMPREHENSIVE, UP-TO-DATE METALWORKING AND DESIGN HANDBOOK YOU CAN OWN!

ENLARGED
192 pages added in the 16th Edition

EXTENSIVELY REVISED
over 500 completely new pages of reference information and data

Whether you are a supervisor, foreman, inspector, toolmaker, machinist, student, or apprentice, you need an accurate, easy-to-use, up-to-date source of specific metalworking information.

Whether your interest is engineering, design, or production, you should have the latest facts, formulas and dimensional data available for ready reference.

Whatever your job, the new 16th Edition of MACHINERY'S HANDBOOK is a necessity. A reliable working handbook that will answer your questions, provide ready solutions to your work problems, give you information you need — when you need it.

Wherever metal products are designed and built, wherever metalworking operations are performed, MACHINERY'S HANDBOOK is the indispensable working reference. For more than 45 years it has been read and referred to on the job in thousands of drafting rooms, machine shops and manufacturing plants . . . saving time, work and money for its users. No wonder over a million and a quarter copies have been sold! No wonder it has earned the reputation as "the bible of the mechanical industries"!

And now, in this greatly revised and enlarged edition, you get all the latest and best principles, practices, specifications, standards and other useful working data. The 16th Edition reflects the tremendous advances the metalworking industries have made; and it gives you the information you need to keep pace with that progress. The comprehensive cross-index and the convenient thumb-index will help you find any one of the subjects in seconds!

Dependable . . . accurate . . . authoritative . . . comprehensive, the new 16th Edition is the largest and best MACHINERY'S HANDBOOK ever published. Yet in physical size it is still a true HAND-book, compact and easy to use. It is the one book you will refer to again and again for the incomparable wealth of information it provides. Send for your copy today!

2104 Pages **$11.00** **Thumb Indexed**

Bound in rugged, durable Sturdite. Stamped in genuine gold.
Printed on tough, thin yet whiter paper for better reading contrast.
Fully thumb indexed. Designed for heavy-duty reference on the job.

THE INDUSTRIAL PRESS
93 Worth Street, New York 13, N. Y.

Bendix SYSTEM-ENGINEERED Numerical Controls log 450,000 hours—with less than 5% downtime

The impressive number of hours logged by machines operated by Bendix® numerical control systems is just one index of leadership in the new era of metalworking. Even more significant is the downtime record. Reports from 30 users show that downtime ranged from 1% to 10%, with an average of slightly less than 5%. Persuasive figures on the practicability of Bendix numerical control systems.

Bendix training and service contribute markedly to maximum machine utilization. Immediately prior to delivery of the machine tool, Bendix trains user personnel who will supervise, operate, and maintain the equipment. When the machine tool is installed, Bendix field men aid in the initial set-up. To assure quality service, Bendix maintains a competent field organization in branch offices throughout the country.

Bendix works closely with machine tool builders. And our numerical controls are *system engineered* to specific applications. Case histories prove that Bendix controlled systems cut production costs, reduce lead time, increase machine tool efficiency, and make parts of consistently high accuracy.

When you consider numerical controls—feasibility, installation, operation—call on Bendix. Investigate our complete line of control systems, both contouring and positioning. Let us explain our proved design techniques, including modular construction, transistorized plug-in circuitry, linear and rotary feedback devices, and high performance servo devices. Find out how Bendix can help you make new profits in metalworking. Write today.

BENDIX PROVIDES SYSTEMS EXPERIENCE

JUSTIFICATION STUDIES • SYSTEM ENGINEERING • TRAINING AND SERVICE

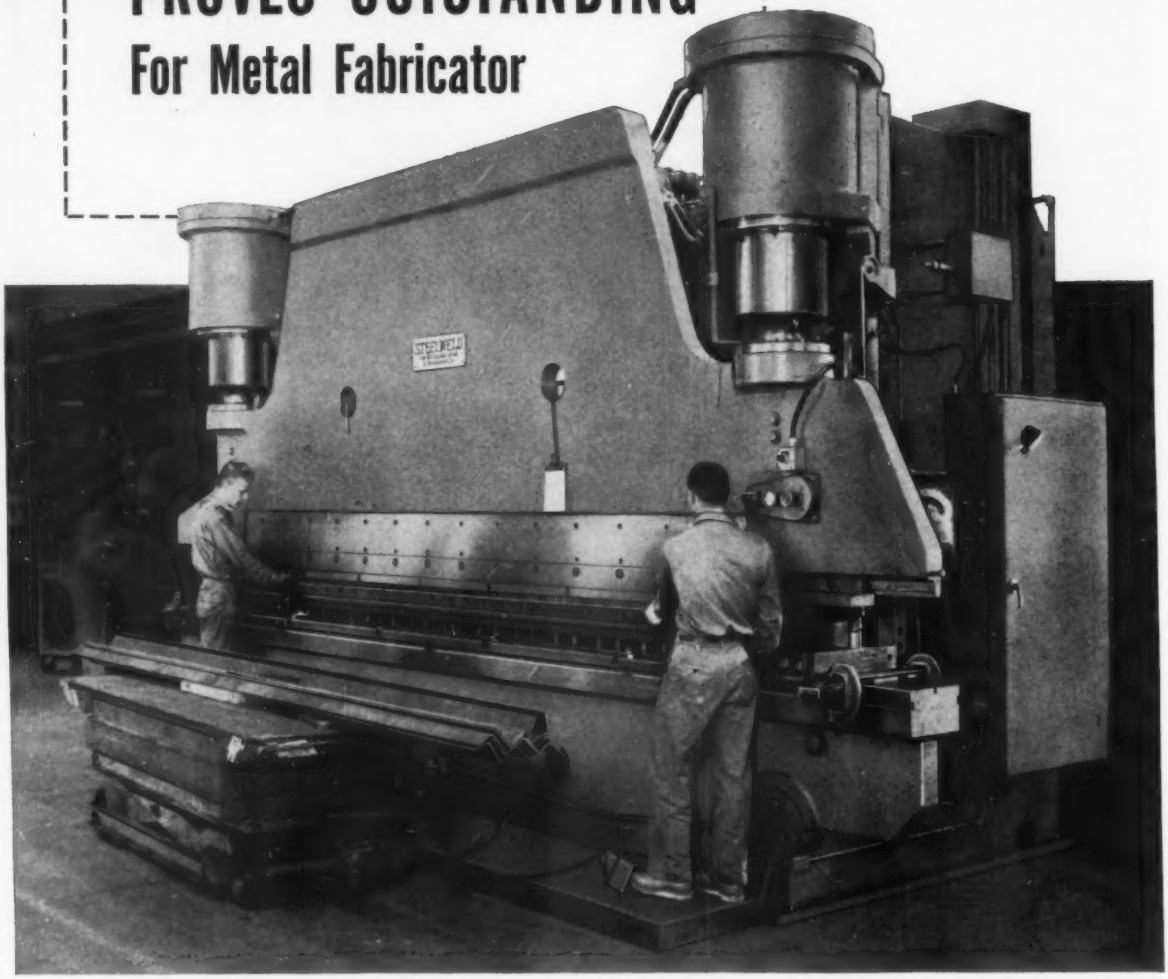
Industrial Controls Section

21820 Wyoming Ave., Detroit 37, Michigan

THE Bendix CORPORATION

Hydraulic Press Brake PROVES OUTSTANDING For Metal Fabricator

Model MH16-14 Steelweld Hydraulic Press Brake. Overall bed and ram length 20'-0". Capacity 650 tons.



A 650 ton Steelweld Hydraulic Press Brake is a mighty important tool at The Bargar Metal Fabricating Co., Cleveland. It performs a wide range of operations such as bending, forming, stamping, punching, drawing.

The brake is especially good for bending large plates, because the ram can be traveled at exactly the right speed to prevent whipping of the plate. Sometimes plates as large as 10' x 20' x ¼" are bent.

The machine is very useful for drawing operations, excelling mechanical press brakes for this work, because it can be operated at the speed that is most suitable for the metal. Also, the ram can be traveled through a greater distance because of the unusually long 16-inch stroke. The power is constant for the entire stroke.

Much punching is done with the Steelweld, and this work is speeded by adjusting the ram stroke to travel only slightly more than the thickness of the plate. The fact that the ram can be inched to the work and backed away whenever desired is another time-saving feature especially helpful when setting up dies.

The Bargar Company has one of the finest and most completely equipped sheet metal fabricating plants in Cleveland. The Steelweld Brake is a good example of their modern production facilities.

Write for free booklet No. 2024

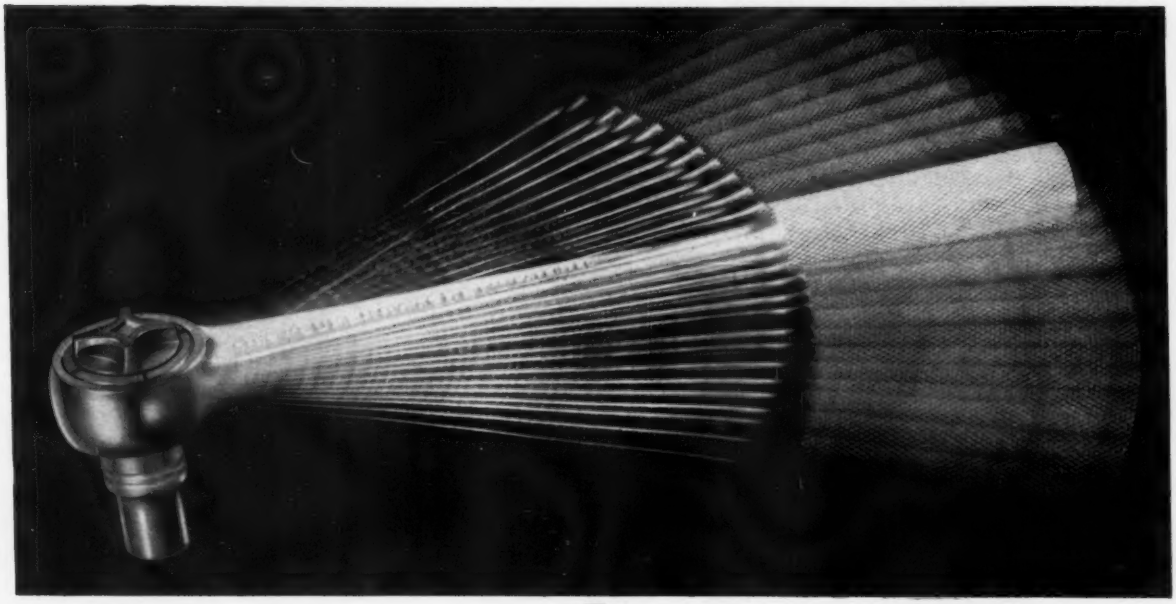
STEELWELD
MECHANICAL and HYDRAULIC
PRESS BRAKES

Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

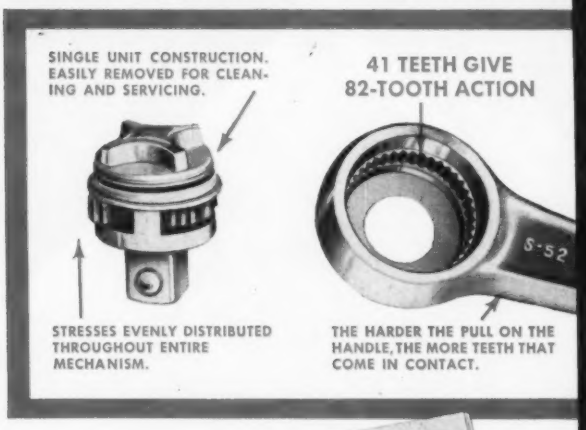
STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 5482 E. 281 ST. • WICKLIFFE, OHIO

Get the swing with WILLIAMS ⅜" and ½" diameter *SUPERRATCHETS*®.

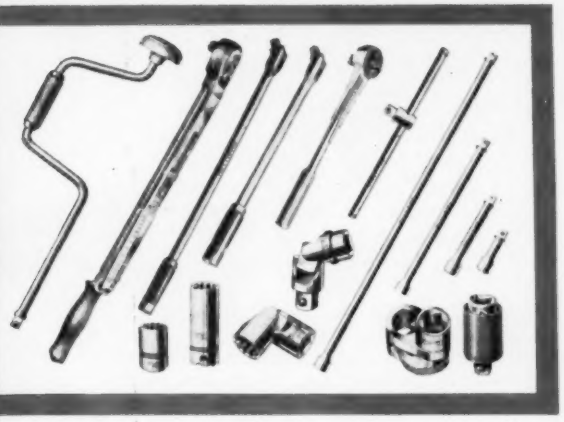
Complete nut rotation requires less than 4½° swing.
Long handle is proportioned for ideal balance, comfort and leverage.

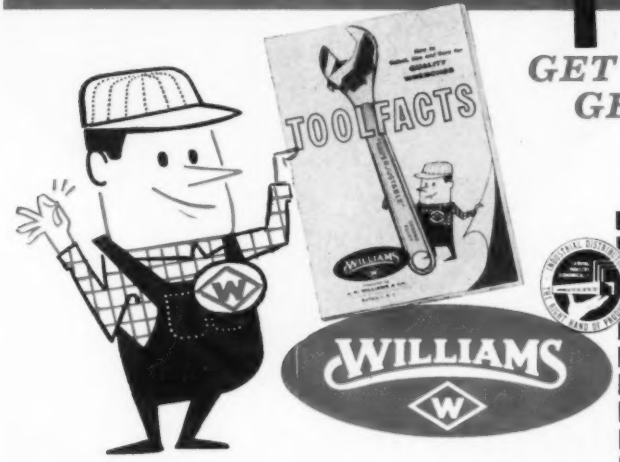


Get the features **Modern design and manufacture combine to produce a ratchet 50% stronger than U.S. Government requirements with these quality features:**



Get the flexibility **88 Drivers and attachments in ¼", ⅜", ½", ¾" and 1" drive sizes, plus 254 sockets, offer endless combinations to solve any nut-turning problem.**





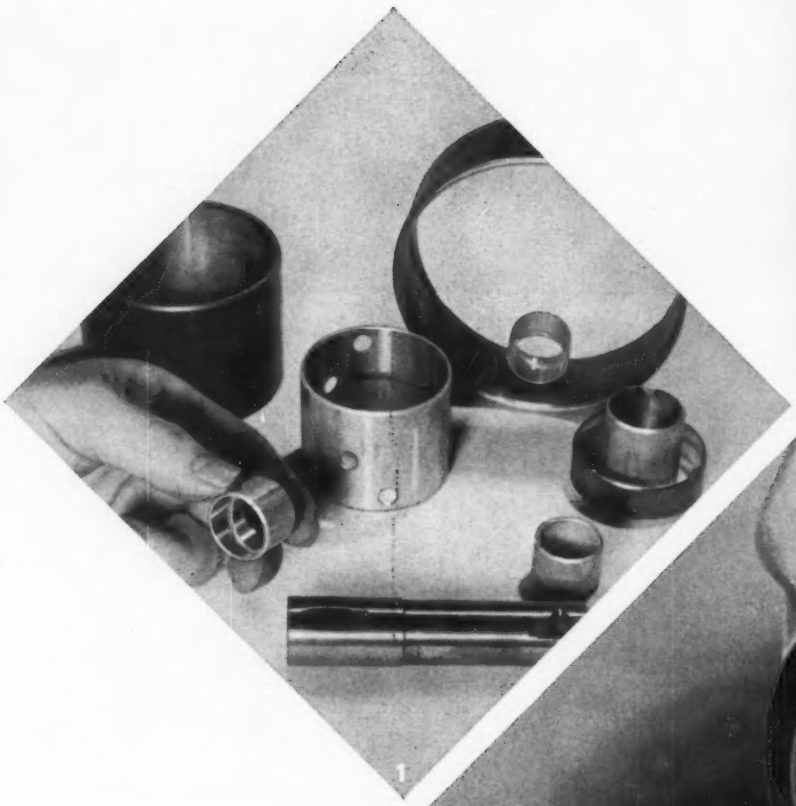
GET THE FACTS... GET TOOLFACTS... MR. WRENCH

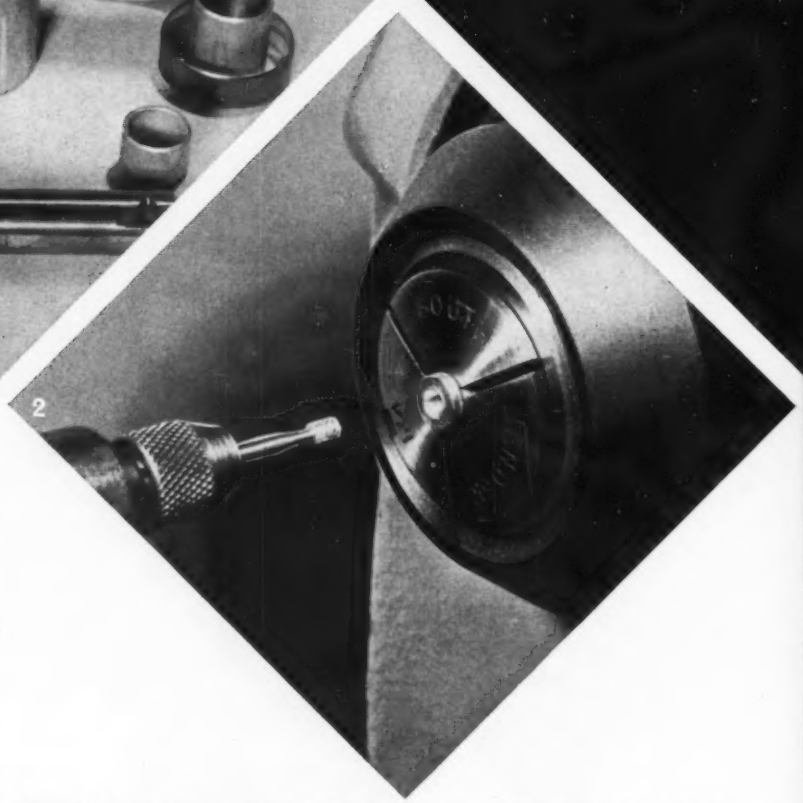
suggests that you send for this New 24-page booklet on How to Select, Use and Care for Quality Wrenches.

J. H. WILLIAMS & CO., 409 VULCAN ST., BUFFALO 7, N. Y.
Division of United-Greenfield Corporation

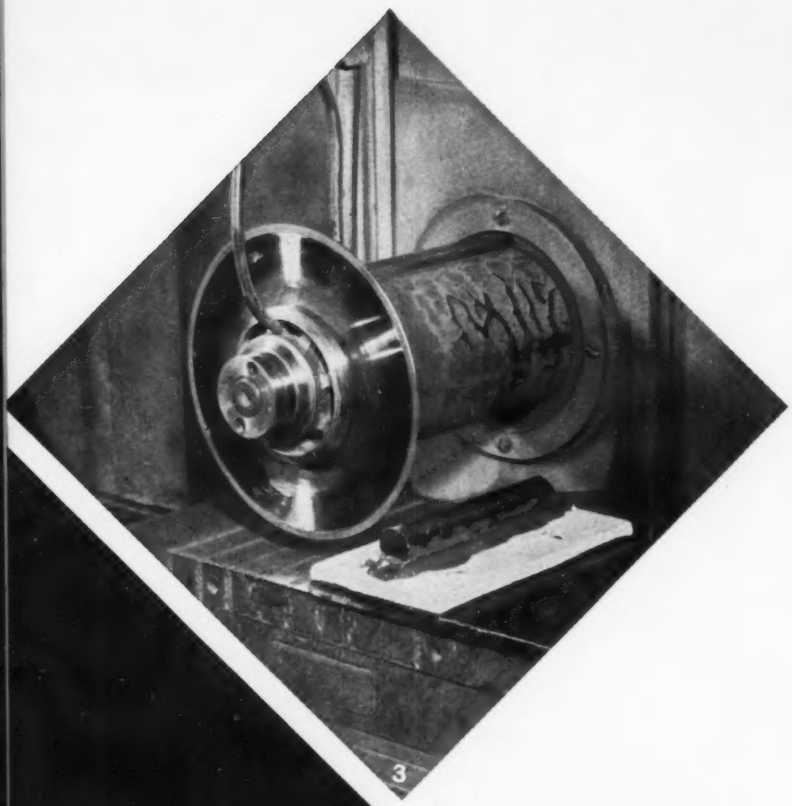
Mr. Wrench: Please send me your new
☐ TOOLFACTS Booklet ☐ ILLUSTRATED CATALOG No. 304

NAME_____ TITLE_____
FIRM_____
STREET_____
CITY_____ ZONE____ STATE____





Industrial Distributors (Sales), Ltd.



Look at the materials (and costs) that diamonds can cut

Everybody knows that industrial diamonds are used to grind and sharpen carbide tools. But did you know that diamonds can also cut and polish nonferrous metals like aluminum and bronze as well as glass, germanium, ceramics, marble?

Diamonds handle all of these jobs because only diamonds possess a unique *combination* of properties: excellent cutting ability coupled with fantastic endurance. Result: diamond tools last longer than anything else you can use. Your people spend more time producing, less time changing tools.

If you cut, sharpen, or smooth in your business, you can probably use diamonds to advantage. Test them against the method you're using. You'll find out how efficient—and economical—a diamond can be, especially now.

Best grit for metal-bond wheels

A new impact crushing method for natural diamonds (developed by the Diamond Research Laboratory in Johannesburg) is producing the strongest and most durable diamond grit ever obtained for metal-bond wheels. Your tool and wheel manufacturer is ready to help you select the diamond tool that's right for *your* job.

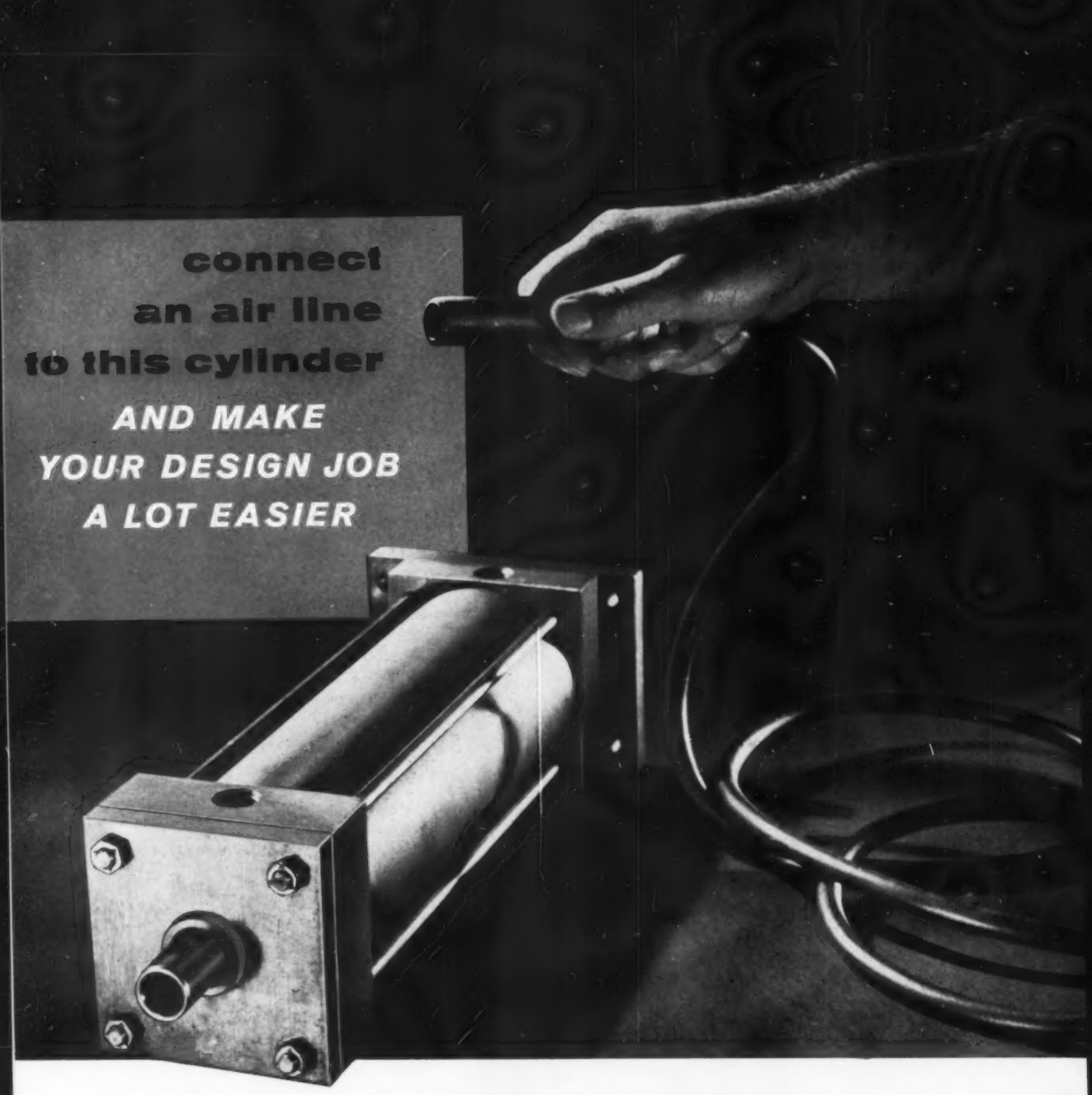
1 **Bimetal Bushings** *made at Federal-Mogul-Bower Bearings, Inc., Detroit, have steel shells with inserts of sintered bronze, tin, lead or aluminum. Diamond boring machine produces 15,000 in one shift. Inside diameters are finish-machined to tolerances of ±0.0005 inch.*

2 **Hardened Steel** *is ground with diamond-coated quills for precision grinding of small internal diameters at National Diamond Laboratory, Peekskill, N. Y. Miniature diamond wheels have greater strength and durability than small grinding tools containing conventional abrasives.*

3 **Germanium and Silicon** *are sliced with diamond wheel at Standard Rectifier Corp., Santa Ana, Calif. Cutters are powdered-metal matrix impregnated with small, blocky natural diamonds. No wear has been visible after months of use.*

4 **Copper-Plated Rollers** *of cast iron, steel or aluminum for gravure printing are smooth-finished in a single pass with diamond lathe tool at Southern Gravure Service, Louisville, Ky. Surface finish of about 6 microinches results. No coolant is required.*

Industrial diamonds cut practically everything... especially your production costs



The cylinder simplifies your design work substantially, because it produces virtually any kind of motion—and does so *without the use of complex mechanical contrivances!*

It provides constant, even pressure at all times, and this pressure can be varied with a simple adjustment. Its compact size, along with the use of a flexible line, makes it easily adaptable to special machine design.

If you would like more information about cylinders, or the many other Logan products, just fill in and mail the coupon below.

LOGAN

AIR AND HYDRAULIC OPERATED MACHINES

Check the items you want, fill in your name and address, tear out and mail to:

Logansport Machine Co., Inc. · 790 Center Avenue, Logansport, Indiana

___100-1 AIR CYLINDERS	___200-1 HYD. POWER UNITS
___100-2 MILL-TYPE AIR CYLS.	___200-2 ROTOCAST HYD. CYLS.
___100-3 AIR-DRAULIC CYLS.	___200-3 750 SERIES HYD. CYLS.
___100-4 AIR VALVES	___200-4 and 200-7 HYD. VALVES
___100-5 LOGANSQUARE CYLS.	___200-6 SUPER-MATIC CYLS.
___100-6 ULTRAMATION CYLS.	___ABC BOOKLET
___100-7 SUB-PLATE AIR VALVE	___CIRCUIT RIDER
___300-1 CHUCKS	___CALCULATOR
___300-2 PRESSES	___FACTS OF LIFE

Please send copy of catalog

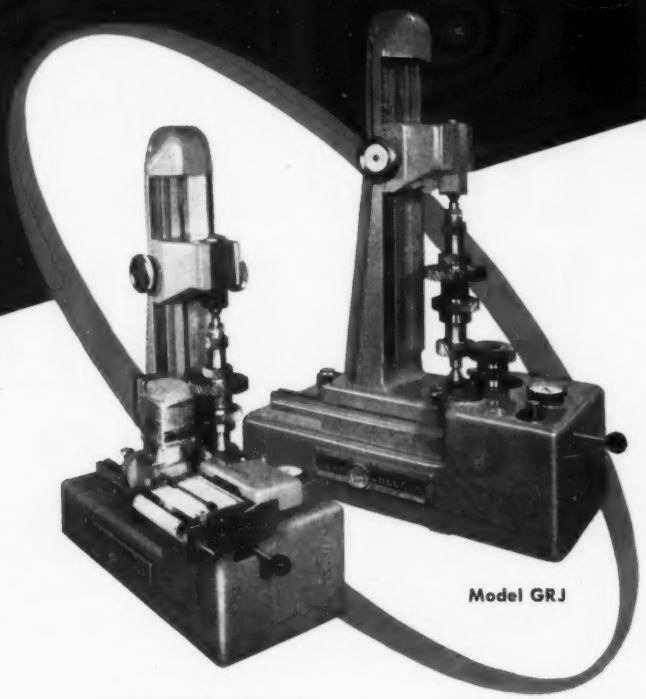
NAME.....

TITLE.....

COMPANY.....

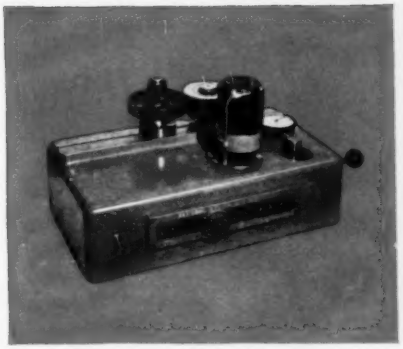
ADDRESS.....

NEW RED RING Gear Rolling Fixtures



Model GRJ

Model GRJ with motor drive and recorder



Model GRH with motor drive

These Red Ring Rolling Fixtures furnish a quick composite check of gear errors such as runout, tooth spacing, tooth profile, helix angle and tooth surface roughness. Model GRH is used for flat gears, Model GRJ for either flat gears or those having integral shafts.

Either model may be equipped with a constant-speed motor drive to eliminate the factor of non-uniform manual operation.

The motorized fixtures may also be equipped with a tape recorder for permanent inspection records.

For further information ask for Bulletin C 60-8

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

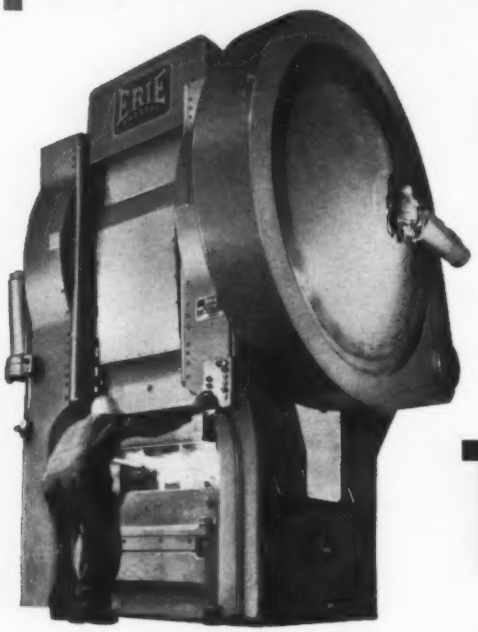
NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING AND HONING EQUIPMENT

WANT TO AUTOMATE YOUR FORGING OPERATION?

You set your production goal . . .



ERIE WILL BUILD THE PRESS

Set your sights on higher output . . . Erie Foundry makes it possible to achieve it, with a high-volume automated forging press. As the first company to automate forging, Erie specializes in custom-designing and building automated presses in capacities up to 8,000 tons.

A single Erie-built automated press, with only one operator-observer, can actually triple your present production rate equalling the output of three regular forging presses and nine production men!

Trimming, too, can be accomplished in a single production cycle. With billet supply and finished part removal conveyorized you can achieve a production volume of, say, 1200 track-link forgings per hour.

To meet your specific needs, Erie Foundry will design a machine for high volume production of such parts as connecting rods, gear blanks, automotive and tractor valves, pinions, track links and wheel hubs.

For the complete story, phone or write Mr. R. E. Sanford, Erie Foundry Company, Erie 1, Pa.

ERIE

ERIE FOUNDRY COMPANY SINCE 1895

ONE OF THE GREAT NAMES IN FORGING

EF-60-03

Manufacturers of Forging Hammers • Forging Presses • Hydraulic Presses • Trimming Presses

J-8082

You get more value for the same dollar— in the NEW Bulletin 709 line of starters!

This new line of Allen-Bradley motor control will change every idea you have had about starter size, performance, and life. The small size—especially in the higher ratings—is startling. Yet rating for rating the operating life and reliability have been increased many times. Built into each of the seven sizes of this new Allen-Bradley line is an ability to interrupt tremendous currents and to operate year in and year out for many millions of operations without trouble or maintenance.

The new Bulletin 709 starters are just as advanced in appearance as they are in performance. All seven sizes have an aristocratic styling and a distinctive family likeness. Brooks Stevens, famous industrial designer, has given the enclosures such an attractive, modern style that these new starters will prove a distinct sales asset on any machine or installation.

Why not write today for more information on this revolutionary new line of Allen-Bradley Bulletin 709 *quality* across-the-line motor starters?

Note the compactness of both the smallest and largest starter in the new Bulletin 709 line. Ratings up to 100 hp, 220 v; 200 hp, 440-550 v.

10-61-RM

ALLEN-BRADLEY

Member of NEMA

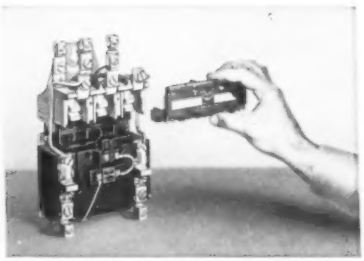
Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

QUALITY MOTOR CONTROL

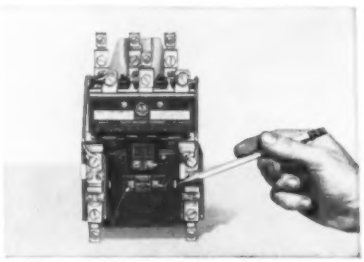
Features of the NEW Allen-Bradley starter line that are of value to you!

New Bulletin 709 Size 3 across-the-line motor starter. Note the generous space for wiring, accessible terminals, and white interior.

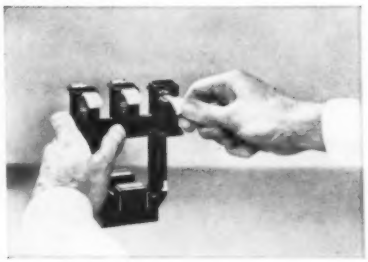
Every detail of the new Allen-Bradley motor starters has been designed to help make this the best line of motor control on the market. Remarkably small in size, each starter is a giant in performance. Being light in weight, these starters are easy to handle and a cinch to install. The generous wiring space, full front wiring, white interiors, and convenient knockouts make installation easy. The enclosure cover is firmly held with a quarter-turn fastener. All installation, inspection, and maintenance operations can be handled from the front—as shown in the illustrations below—without the use of special tools.



QUICK, EASY CONTACT INSPECTION—When the arc hood front cover is removed by loosening two captive screws, contacts are plainly visible from the front.



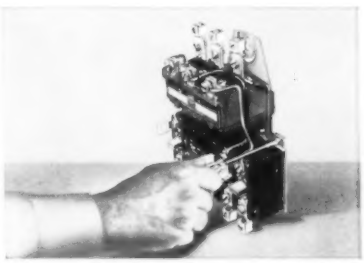
CONTACT POSITION INDICATED—Two slots in the coil cover show the position of the movable contact support—tell whether contacts are "closed" or "open."



CONTACTS EASILY REPLACED—Depress the spring slightly, and the movable contacts can be lifted out of the molded support and the new contacts slipped in.

COIL EASILY CHANGED—When the coil cover is removed, coil and magnet yoke can be lifted out from the front. They are impossible to replace incorrectly.

AUXILIARY CONTACTS EASILY ADDED to the front of the starter. Two extra auxiliaries can be added to Sizes 0, 1, and 2 starters, and four, to Sizes 3, 4, and 5.



A THIRD OVERLOAD RELAY CAN BE EASILY ADDED in the field, from the front of the starter. And the only tool needed is a common screwdriver.

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

QUALITY MOTOR CONTROL

NEW. . .MASTER COMPARATOR

MODEL 136B-2

The best thing about this high-precision electronic Comparator is its accuracy and operating convenience. The next best thing is its amazingly modest price*!

The model 136B-2 measures any master ring from .040″ to 4.760″ and any master disc up to 3.500″ with repetitive accuracy to within two millionths of an inch! It measures with constant force, frictionless response, requires no warm-up.

This Horizontal Master Comparator is in a class by itself. It is one of the very few having the inherent design capability of **properly** and **reliably** checking Class XX masters, yet is far lower in price than **any** other high precision master comparator.

This is only part of the story. Send for full details.

FEDERAL PRODUCTS CORP.
1116 Eddy Street, Providence 1, Rhode Island

*$1950. plus Jaws @ approx. $100. per pr. (Complete set, 7 prs.)

Ask **FEDERAL®** *First*

for recommendations in modern gages... Dial Indicating • Air • Electric or Electronic — for inspecting, measuring, sorting, or automation gaging.

Thompson's exclusive "CYBERMATIC PENDANT CONTROL" completely eliminates the elevating hand wheel

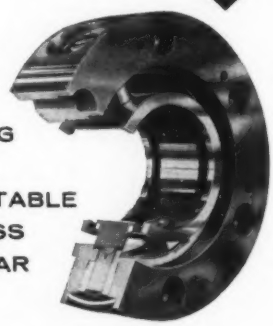
All vertical movement of the wheel head, both automatic and manual, on this modern Thompson 36 x 48 x 72 Type CX Plunge-Matic Grinder is accomplished effortlessly by dials on the Cybermatic Pendant Control.

This new pendant control performs the following functions: **Sets automatic down feed from .0002" to .006" in .0002" increments—sets the total amount of automatic down feed for stock removal from 0 to 1 inch through the entire 48" vertical capacity—controls automatic down feed increment (as pre-selected) at each reversal of the wheel head on cross feed or at each table reversal on straight plunge feed — controls a 20" per minute rapid traverse to the elevation of the wheel head—provides a push button to re-set the down feed range at operator's will — pre-sets a wheel dressing increment for automatic wheel trueing—compensates manually or automatically for wheel dressing —provides a master stop button for all movement.**

This Thompson machine is completely modern in every respect. Its features include the exclusive Thompson Hydra-Cool Hydraulic System with dual packless cylinders providing automatic cushioning. A separate automatic lubrication system for all sliding way bearings and tape bed way covers are standard equipment.

This modern Thompson grinder is both high powered and extremely accurate.

Further specifications will be furnished upon request.



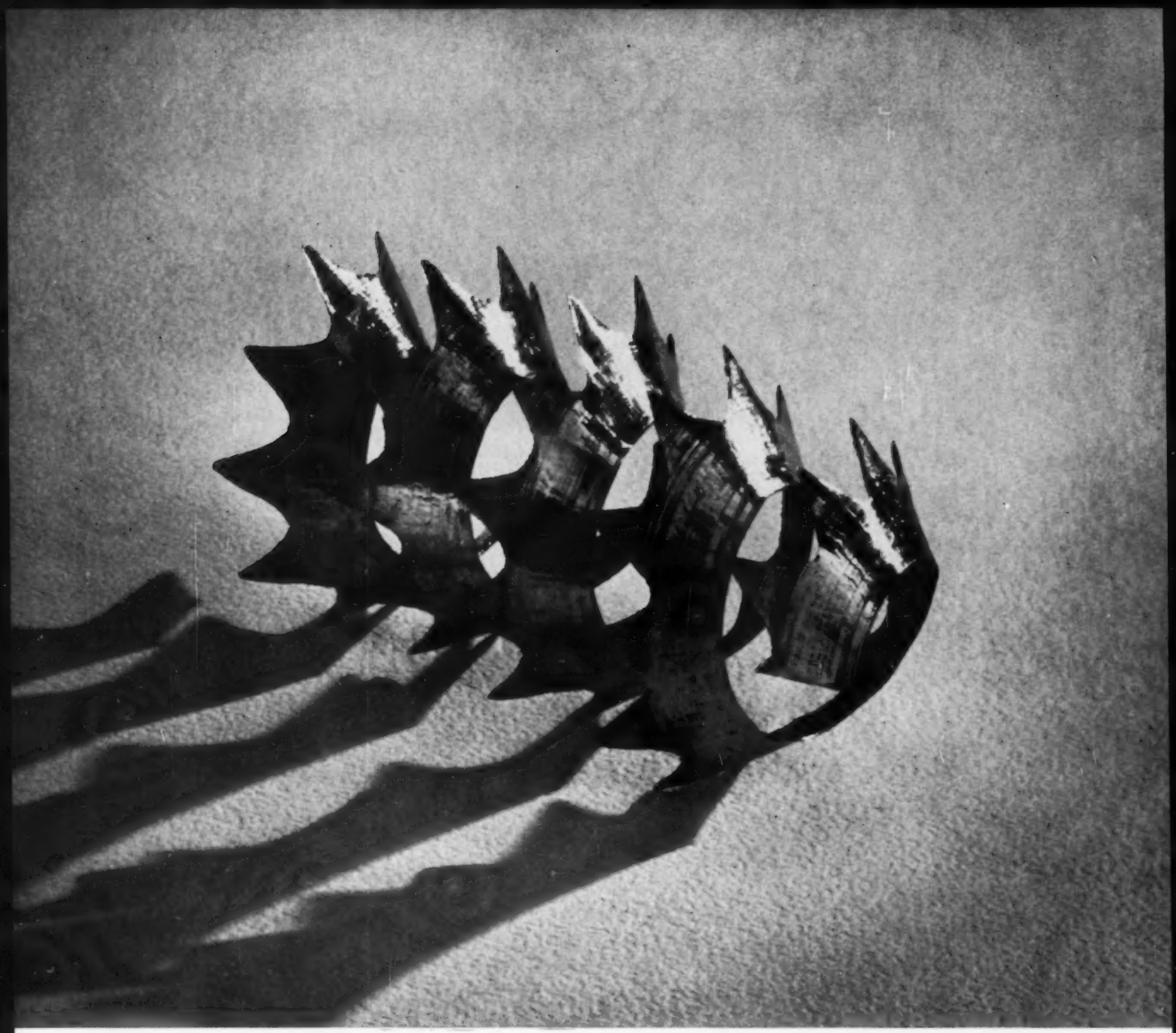
PRE-LOADED
SELF-ADJUSTING
COLD RUNNING
ROTATIONALLY STABLE
VIBRATIONLESS
FREE FROM WEAR

Thompson has taken another important step toward the ultimate in accuracy and precision by obtaining the exclusive use of the world famous MALCUS BLOCK BEARINGS for their wheel head spindles. The notable advantages of these bearings are listed above.

Thompson SURFACE GRINDERS

THE THOMPSON GRINDER COMPANY • SPRINGFIELD, OHIO

"Keep Thompson in mind for that daily grind"



Chip – magnified 4 times – produced by machining Waspalloy with Rex 49

New Rex 49 outlasts other special purpose high speed steels better than 2 to 1

Rex 49 – a new high speed steel that can machine today's "difficult-to-cut" metals *faster and more economically* than existing special purpose high speed steels – is another in the long line of advances and improvements in specialty steels to come from Crucible research.

Crucible laboratory tests indicate that tools made of Rex 49 last as much as 4 times longer than other special purpose high speed steels . . . and it has a base price ⅓ to ½ of these steels.

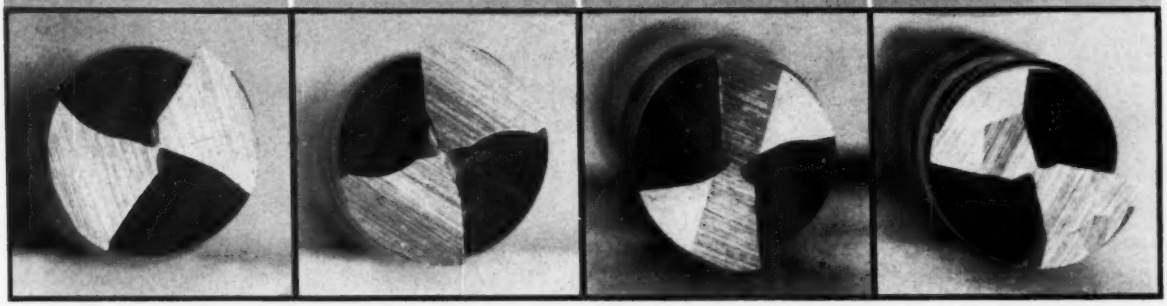
Both laboratory and field reports prove the advantages of Rex 49 for machining hard, tough or abrasive metals, such as heat-treated alloy steels, stainless, titanium, and superalloys. These tests also indicate that Rex 49 has advantages in machining the more conventional metals through increased speeds, feeds and depths of cut — and Rex 49 can be hardened with conventional high speed steel heat treating equipment.

Rex 49 is indicative of Crucible's continuing leadership in the development of improved high speed and tool steels.

For more information, write: *Crucible Steel Company of America, Dept. HF20, Four Gateway Center, P. O. Box 88, Pittsburgh 30, Pa.*

CRUCIBLE STEEL COMPANY OF AMERICA

⅛" drill with point thinned, negative rake — four chip cutter which produces small, broken-up center chip.	⅛" drill with point thinned, 27% cutting lip reduction, negative rake — four chip cutter which produces small, granular center chip.	⅛" drill with secondary relief angle, point thinned, negative rake — four chip cutter producing granulated center chip.	⅛" drill with four relief angles, projecting point, point thinned, 13.5% cutting lip reduction, negative rake — a six chip cutter producing granulated center chip, no burr.



only DrillPointMaster gives you this precise control of point geometry

LELAND-GIFFORD'S new DrillPointMaster will sharpen, relieve and thin any drill from #80 to .250" diameter . . . lets you produce the ideal point geometry for any drilling job — then duplicate that point precisely time after time.

Check the many exclusive features listed at the right, then add these extra benefits:

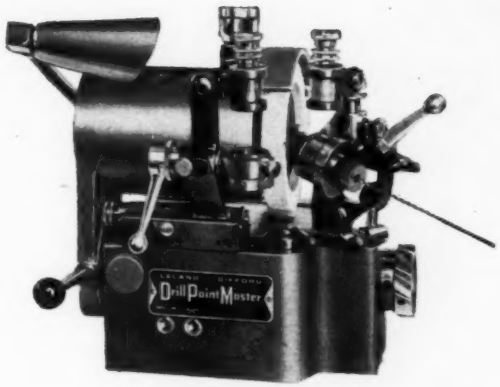
Removes only .003" to .005" in renewing point. Normal practice requires .030" or more, wasting up to 90% of useful length.

Grinds at right angles to cutting edge. Conventional grinders leave grit marks parallel to lip which quickly break down, dull the tool, generate excessive heat.

Drills are centered and located by means of precision collet chuck and microscope viewers. All other methods perpetuate errors resulting from lip wear or inaccuracies in the drill.

Will grind *left hand drills* and, with a diamond wheel, does an excellent job on *carbide drills*.

Get the whole story on the Leland-Gifford DrillPointMaster. Write, wire or phone for an in-plant demonstration — or for complete information.



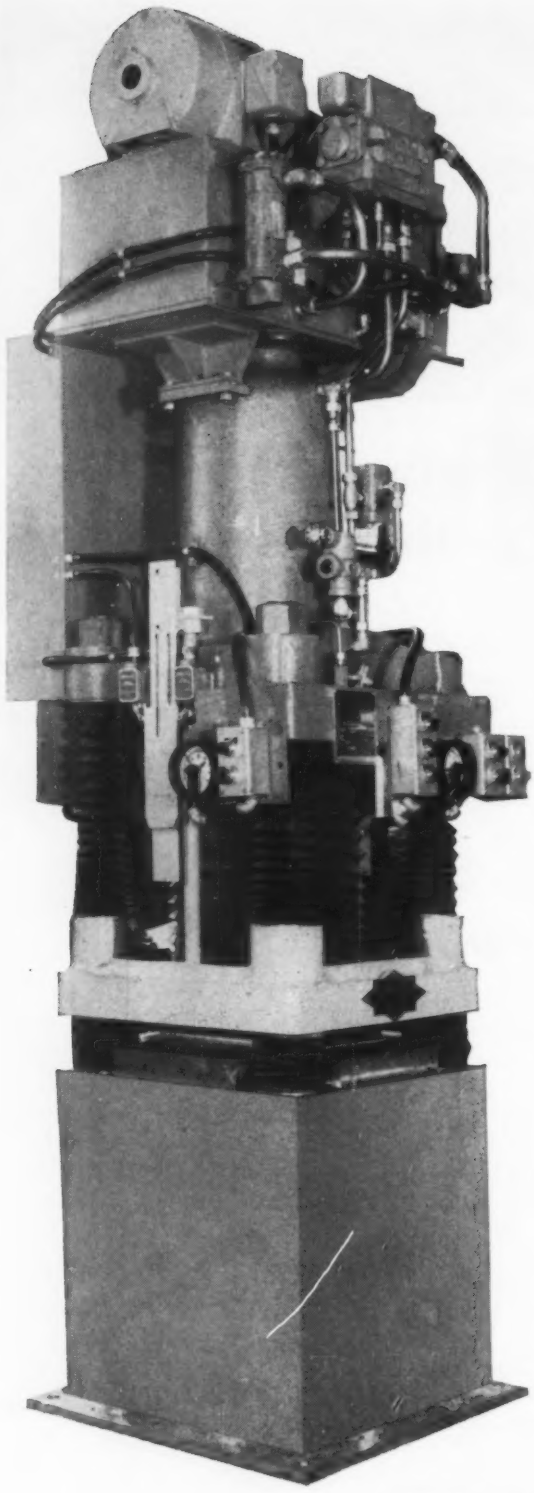
FEATURES

- Point angle adjustment set from 60° to 180° included angle.
- Lip relief adjustment from 0° to 26°.
- Wheel slide and point thinning carrier micrometer adjusted.
- One collet chuck serves both sharpening and thinning positions.
- Only a few collets needed for all drill sizes.
- Special sandwich wheel for clean, dry grinding and thinning without burning.
- Two variable power microscope viewers plus sealed beam light for precise setting and inspection.

LELAND-GIFFORD

WORCESTER 1, MASSACHUSETTS

DRILL POINT MASTER DRILL GRINDER



JUST PLAIN VERSATILE

■ **New Birdsboro press shapes up to 4 different grinding wheels at the same time... yet need not work in sequence.**

Here's good news for grinding wheel manufacturers: a hydraulic press so versatile that four operators can shape up to 4 different wheels—without working in sequence! Each station can be set for different tonnages (from 5 to 100) and different approach strokes. Safety inspectors get advantages, too . . . a safety interlock, dust protector boots, and emergency safety return push-buttons at each station.

The Birdsboro men who designed and built this press are ready to tackle *your* next press *now*. Just write: *Sales Department:* Reading, Pa., *Engineering Department and Mfg. Plant:* Birdsboro, Pa., *District Office:* Pittsburgh, Pa.

HP46-60

BIRDSBORO
CORPORATION BIRDSBORO, PENNA.

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • ROLLS • ELECTRIC STEEL CASTINGS: Carbon, Low Alloy and STAINLESS STEEL

Take a Ledloy® steel—Inland's famous family of free machining steels—and give it all you've got! Go on—double and triple your normal speeds. Up to 325 sfm is common with Ledloy and believe us, far greater speeds are perfectly possible—up to 450 sfm with high speed tools —600 sfm with carbide tooling. ■ Step up the feed, too. Drill at 40 inches per minute at 750 rpm if you have the equipment for it. Matter of fact, you can't tell how much faster—better—you can do with a Ledloy steel 'til you've pushed it to the limit. ■ One thing to remember—you won't get these amazing results with just any leaded steel. To get the most out of your equipment, use Inland Ledloy—the original leaded steel. ■ That's right—Inland made leaded steels long before anyone else—has been developing the unique properties of Ledloy steels for more than 20 years—can recommend exactly the right type for your shop and your product. So use Ledloy steels—hit them with all you have...

LEDLOY® STEELS CAN TAKE IT!

the world's most machinable steels

INLAND STEEL COMPANY
30 West Monroe Street • Chicago 3, Illinois

INLAND®

MARLIN-ROCKWELL RELIABILITY COUNTS in QUALITY POWER TOOLS by Black & Decker®

Black & Decker
#11 Heavy Duty Jig-Saw

MRC Ball Bearings have contributed to the reliability of Black & Decker Power Tools for over 25 years.

There is an MRC Ball Bearing for every application. Sizes range from small bearings, used in delicate instruments, to extra-large bearings, used in heavy-duty machinery.

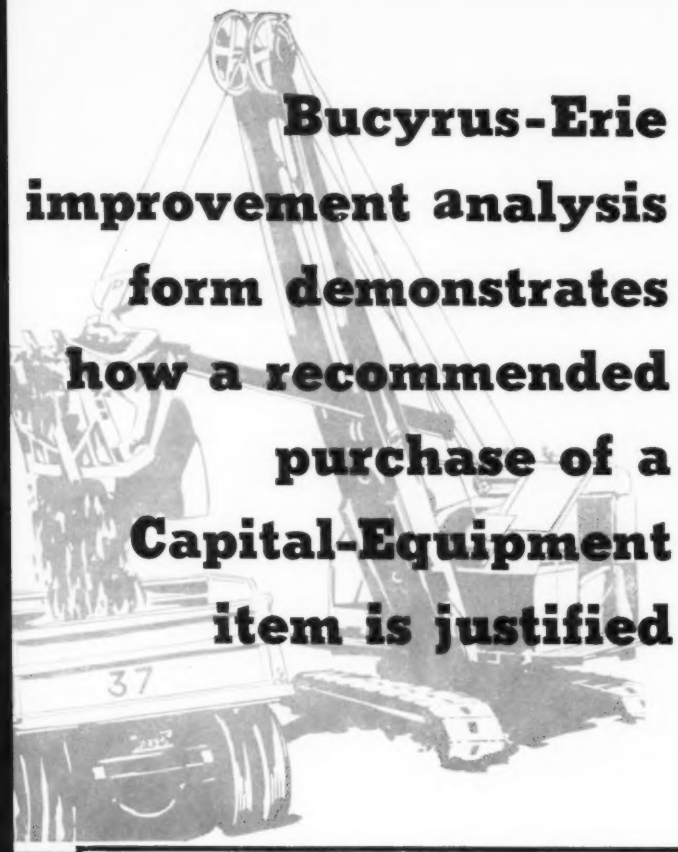
Backed by 63 Years Experience

Consult OUR Engineering Department on YOUR Bearing Problems

MRC
BALL AND ROLLER *bearings*

MARLIN-ROCKWELL CORPORATION

Executive Offices: **Jamestown, N. Y.**



Bucyrus-Erie improvement analysis form demonstrates how a recommended purchase of a Capital-Equipment item is justified

In a statement published on this page in October, 1959, the Bucyrus-Erie Company of South Milwaukee, Wisconsin, producer of excavating and drilling equipment, explained its replacement-program goal as "an annual facilities program which will result in the greatest return for the expenditures made."

To give management information on which to base a buying decision concerning new equipment for replacement or for expanding production, data is presented in the following form:

1. A plain "pay-off" period.
2. The return on investment (based essentially on the new MAPI Formula).
3. An urgency rating arbitrarily made by the division originating the request for investment.

It is to be noted that the M.A.P.I. principle assumes that the savings for each succeeding year would be the same as for the first year. In certain instances where Bucyrus-Erie can predict a variation in the economic factors, the company makes use of a more sophisticated "cash flow" analysis. This latter form is shown here. While the figures are not from an actual example, they do illustrate the use of the form and the results of an investigation of the merits of new equipment versus retention of the old.

This is another example of how the Rockford Group of Machine-Tool Builders continues to furnish information concerning the workings of forward-looking companies in their efforts to obtain the greatest possible return from the use of invested capital.

IMPROVEMENT ANALYSIS BE-2803-B

ALTERNATIVE I (RECOMMENDED): Purchase new machine tool--sell present machine tool for $50,000.

ALTERNATIVE II: Continue to use present machine tool and sub-contract excess work load.

	YEAR	1 PURCHASE COST AND/OR BOOK VALUE OF ASSET	2 ADDITIONAL INVESTMENT REQUIRED TO BE CAPITALIZED (INCLUDING SALVAGE VALUE OF REPLACED ASSET)	3 CAPITALIZED COST OF INVESTMENT (COLUMN 1 PLUS COLUMN 2)	4 ACTUAL DEPRECIATION FROM BOOKS (OR TAX RECORDS) OF ASSET	5 YEAR	6 ESTIMATED OPERATING COSTS PER YEAR	7 DIRECT LABOR	8 INDIRECT LABOR	9 FRINGE BENEFITS	10 MAINTENANCE	11 TOOLING	12 SCRAP & REWORK	13 DOWNTIME	14 POWER	15 MATERIAL	16 PROPERTY TAXES	17 INSURANCE	18 SUB-CONTRACTING	19 INVENTORY @ 6 %	20 SAFETY	21 FLEXIBILITY	22 FLOOR SPACE 30 ft² @ $10 PER FT	23 ACTUAL COSTS OF OPERATION (COLS. 6 THROUGH 21)	24 DEPRECIATION
ALTERNATIVE I		91,500	10,000	101,500	0																				
					1	6000	18000	12000	6000	500	500	Same	Same	Same	10000	9099	5	0	200	Same	Same	Same		55595	7575
					2	6000	18000	12000	6000	1000	500				10000	8635	4	0	200					55834	7575
					3	6000	18000	12000	6000	1000	500				10000	8180	4	0	200					55580	7575
					4	6000	18000	12000	6000	1000	500				10000	7729	4	0	200					55429	7575
					5	6000	18000	12000	6000	1500	500				10000	7270	4	0	200					55474	7575
					6	6000	18000	12000	6000	1500	500				10000	6815	3	0	200					55018	7575
					7	6000	18000	12000	6000	1500	500				10000	6360	3	0	200					54563	7575
					8	6000	18000	12000	6000	2000	500				10000	5905	3	0	200					54608	7575
					9	6000	18000	12000	6000	2000	500				10000	5450	3	0	200					54154	7575
					10	6000	18000	12000	6000	2000	500				10000	4995	3	0	200					53698	7575
ALTERNATIVE II					0																				
					1	6000	18000	24,000	8400	3000	750	Same	Same	Same	2490	1	20000	0	Same	Same	Same		79611	4100
					2	6000	18000	24,000	8400	3000	750				2214	1	20000	0					79365	4100
					3	6000	18000	24,000	8400	3000	750				1968	1	20000	0					79119	4100
					4	6000	18000	24,000	8400	4000	750				1722	1	20000	0					78873	4100
					5	6000	18000	24,000	8400	3000	750				1476	1	20000	0					75627	4100
					6	6000	18000	24,000	8400	3000	750				1230	1	20000	0					75381	4100
					7	6000	18000	24,000	8400	6000	750				984	0	20000	0					78134	4100
					8	6000	18000	24,000	8400	3000	750				738	0	20000	0					74888	4100
					9	6000	18000	24,000	8400	3000	750				492	0	20000	0					74642	4100
					10	6000	18000	24,000	8400	3000	750				246	0	20000	0					74326	4100

CASH FLOW

ALTERNATIVE I - ALTERNATIVE II

YEAR	A DIFFERENTIAL IN OPERATING COSTS; SAVINGS OR (EX. PENSE) (COLUMN 22 ABOVE)	B DIFFERENTIAL DEPRECIATION (+ IF GREATER SMALLER) (COLUMN 23 ABOVE)	C EFFECT ON PROFIT & LOSS STATEMENT BEFORE FEDERAL INCOME TAXES (A+B)	D FEDERAL INCOME TAXES 52% TIMES (-) C (GREATER) OR LESS	E DIFFERENTIAL CASH FLOW FROM SALE OR (PURCHASE) OF ASSET (COLUMN 4 ABOVE)	F CAPITAL (GAIN) OR CAPITAL LOSS	G TAX (OUTFLOW) FROM CAPITAL GAIN OR IN-FLOW FROM LOSS F TIMES 25%	H EFFECT ON PROFIT & LOSS STATEMENT AFTER FEDERAL IN-COME TAXES (C+D+G)	I NET DIFFERENTIAL CASH INFLOW OR (OUTFLOW) (A+D+E+G)	J COMPOUNDING FACTOR	K FUTURE VALUE OF NET DIFFERENTIAL CASH FLOW (I TIMES J)
DAY	A	B	C	D	E	F	G	H	I	J	K
1	21,316	(3475)	17,841	(9277)	(101,500)	(9000)	(2250)	6564	(103,750)		56,000
2	20,026	(3475)	16,551	(8607)				7294	11,419		21,000
3	20,235	(3475)	16,760	(8715)				7045	11,520		23,000
4	21,444	(3475)	17,969	(9344)				6625	12,100		24,000
5	20,153	(3475)	16,678	(8673)				8005	11,480		19,000
6	20,363	(3475)	16,888	(8782)				8106	11,581		33,000
7	23,571	(3475)	20,096	(10450)				9646	13,121		10,000
8	20,280	(3475)	16,805	(8737)				8068	11,543		9,000
9	20,489	(3475)	17,014	(8847)				8167	11,642		8,500
10	20,689	(3475)	17,223	(8956)				8267	11,742		50,000
DIFFERENTIAL SALVAGE VALUE AFTER 10 YEARS OR OTHER PERIOD CONSIDERED - ALTERNATIVE 1 MINUS ALTERNATIVE 11 - GREATER OR (LESS)										TOTAL FUTURE VALUE OF CASH FLOW	257,500

OTHER ALTERNATIVES CONSIDERED — RATE OF RETURN

ALT. III _____ vs ALT. II _____

ALT. IV _____ vs ALT. III _____

TOTAL FUTURE VALUE CASH FLOW 257,500 — RATE OF RETURN FACTOR 2.48

PRESENT NET DIFFERENTIAL CASH FLOW (LINE 0, COLUMN I) 103,750 — % RATE OF RETURN AFTER TAX 9%

DATE August 11,1960

PREPARED BY J. Doe

PROJECT NO _____

Keep gathering metal-working production ideas . . . be well informed when you replace machinery.

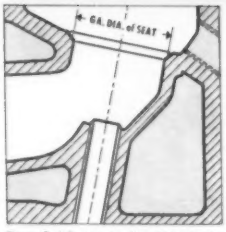
Rockford Insert Group

Requirements:

ACCURACY
CONVENIENCE
DEPENDABILITY

. . . but the high production of a progress-thru machine not demanded of this valve-seat and stem-hole finishing machine

W. F. & John Barnes Special Vertical Valve-Seat and Stem-Hole Finishing Machine, with 2-position rotary table, manually loaded. Equipped with Barnes dual-type precision spindles, having facing and gun-boring tools. Inner spindle for stem hole, outer spindle for seat. Production 34 parts per hour gross.



Fine finish to precise tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of valve seat is held to .0005" total indicator reading.

The requirements of the customer placed emphasis on accuracy, ease of operation, and dependability; but high-speed production was not demanded. As a result, this finishing machine has met all requirements and has proved to be a very profitable investment. Its continuous accuracy and the fine finish it produces as a result of the tooling method eliminates the need for reaming or other final finishing operations. And for this type of machine, its production is very high.

Where production demands do not exceed the limits of this compact unit, adaptations can be made to handle all types of valve jobs on small or large cylinder heads. When higher production is required, a W. F. & John Barnes Progress-Thru type of transfer machine will provide it and with very high efficiency. But regardless of your requirements, Barnes' broad experience assures you of receiving a fine machine with all the cost-cutting features of the most modern equipment.

Ask for an Analysis of Your Machining Methods

W. F. & JOHN BARNES

Builders of Better Machines Since 1872.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Barnes engineers are ready to work with you to improve production methods and cut machining costs. Write for descriptive literature.

MULTIPLE-SPINDLE DRILLING, BORING, TAPPING MACHINES • AUTOMATIC PROGRESS-THRU TRANSFER-TYPE MACHINES

June, 1961

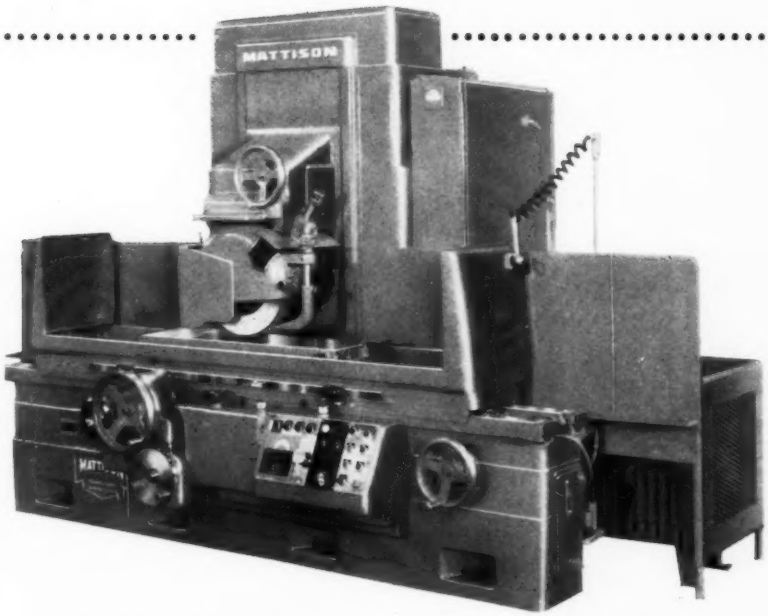
For more data circle No. 816 on card at back of book.

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION

GRINDING METHODS

New Mattison Horizontals speed precision surface grinding



Here is Mattison's new line of horizontal-spindle surface grinders, with more rigidity, more power actuation, and more automatic features to speed work and control your quality.

Here, in surface grinders ranging from 36″ to 192″ in table length, is all the precision you need for toolroom surface grinding, plus high production capacity for the shop. Here is "hogging" power and rigidity combined with high sensitivity of a light-duty machine tool.

Operation of the new Mattison is easier and more automatic because cross feed is electronically controlled in both directions. The operator just presets the feed increment and reversal points on the new illuminated station—the wheel slide automatically feeds and stops within ± 1/16″ of either edge without work stoppage. Twin cylinder actuation assures uniform speed of the cross slide. With optional automatic downfeed, electronic reversal makes grinding easier than ever.

Automatic cross feed resets after wheel dressing

Should the operator override the automatic feed to dress the wheel, simply releasing the manual lever causes wheel slide to reset itself to the correct direction and resume operation between preset reversal points.

On long grinding operations, Mattison's new power downfeed increases productivity greatly. Amount of downfeed is set to a predetermined stop, from .001″ to .400″, in increments of from .0002″ to .004″ in ranges. On plunge grinding operations, downfeed actuation can be controlled by table reversals. Or, when grinding in the conventional manner, it may be controlled from cross slide reversals. A microswitch shuts off the feed at a predetermined depth of cut, after which the machine sparks out. This new feature is optional on all new horizontals.

Box-type construction increases rigidity and sensitivity

Performance has proved the superiority of our double-column machine—and now the Meehanite columns, wheel slide, and spindle housing all are beefed up and functionally changed to bring you the finest double-column design ever. Wide, deep, box-type columns are bolted and doweled to the Meehanite base and reinforced at the top by a heavy connecting brace. This gives you rigidity of a one-piece casting. The 30″, 36″, and 42″ machines are standard equipped with hydraulic counterweighting. This permits you to preload the feed screw in either direction increasing control on precision work.

New system of ways and gibbing permits closer adjustment and accentuates the machine's sensitivity to fine-feed actuation.

Table speeds increased through variable volume pump

You can take advantage of high horsepower and rigidity because Mattison table speeds go up to 125 ft per minute, or more. The new style pump has internal hydraulic reversing, for quieter, smoother, and cooler operation. Complete hydraulic unit is isolated from the machine, avoiding heat build-up and possible distortion of the table or work.

Power assist simplifies manual control

A new auxiliary power system permits the operator to control table positioning more easily and precisely by hand instead of by jogging the hydraulic system. Optional power assist on large machines permits fingertip actuation through the handwheel, even when positioning a table load of heavy castings. This facilitates dressing the wheel from a table-mounted diamond or crush roll. All levers and handwheels on this machine are directional.

If you have large accurate parts . . . if you are a volume producer of precision-ground flat stock . . . or if you just want to increase productivity in the toolroom, contact your Mattison dealer for information on this new line of high-powered precision surface grinders.

MATTISON MACHINE WORKS
Rockford, Illinois Phone: WO 2-5521

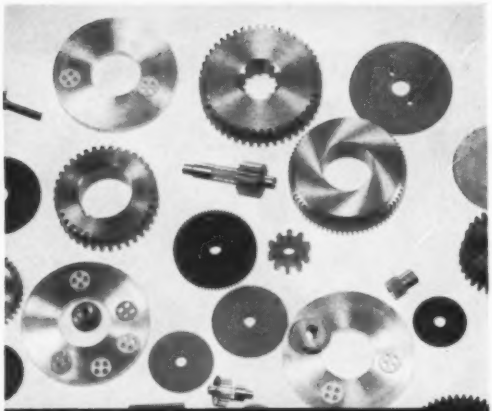
MATTISON MACHINE WORKS ROCKFORD, ILL.

HIGH-POWERED PRECISION SURFACE GRINDERS

For more data circle No. 817 on card at back of book.

June, 1961

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

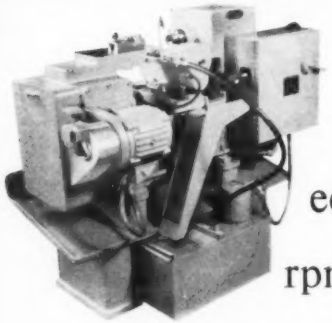


■Here is an opportunity to add powerful sales appeal to your product without increasing costs. As a result of recent Barber-Colman innovations in hobbing, it is economically feasible to put instru-

NEW

ment gear quality into any product. / The new method is production hobbing of fine-pitch spur gears of AGMA Precision Class 3 quality... quality which cannot be produced economically by any other method. It's the new No. 2½-4, a machine which Barber-Colman guarantees will index accurately within 20 seconds of arc. This means that in a 2″ diameter gear, nonadjacent tooth-spacing error caused by machine indexing can be held within

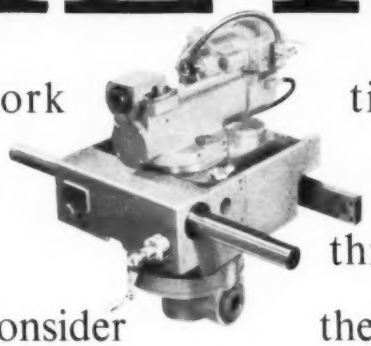
.0001". / This extraordinary precision has been combined with economy through machine simplicity. The position of the work

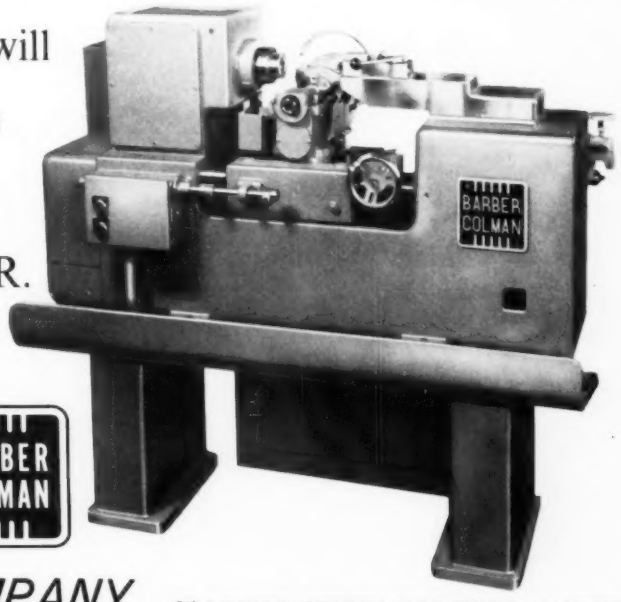


spindle of the No. 2½-4 is fixed, increasing rigidity. Hob carriage is completely antifriction-equipped. Hob speed is infinitely variable to 1200 rpm. A stiff, direct-feed drive eliminates error in

METHOD

hob-to-work timing. These and other unique machine features are triggering important break-throughs in gear-cutting cost and quality. Consider the total impact of product improvement through precision gearing in your industry—of "cost-free," plus values your customers will recognize and buy. / See the No. 2½-4 hobbing your gear blanks in our TEST CENTER. Your Barber-Colman representative will make all the arrangements.





BARBER COLMAN

BARBER-COLMAN COMPANY 62 LOOMIS STREET, ROCKFORD, ILLINOIS

For more data circle No. 818 on card at back of book.

June, 1961

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

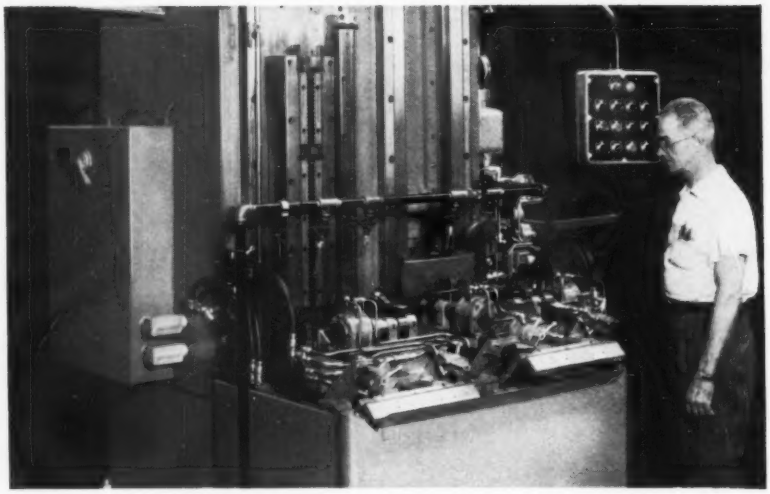
how to improve your broaching methods with SUNDSTRAND "ENGINEERED PRODUCTION

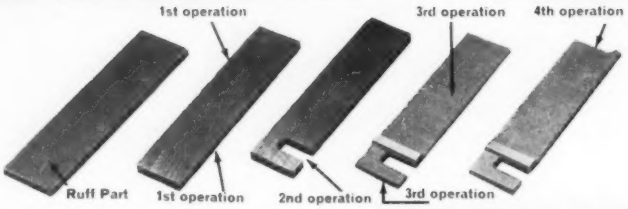
A Sundstrand "Engineered Production" analysis of the problem of machining over 200 different sizes of mold liners determined that a single Sundstrand-American dual-ram surface broaching machine with specially designed adjustable fixturing would do the job at minimum cost, considering machine investment and production time.

An individual fixture station is provided for each of the four operations shown at the right, two fixtures being located at each ram. All operations are performed in one cycle at the rate of over 100 pieces per hour. Stations are loaded and unloaded by the operator. Fixture clamps and 45° sliding tables operate automatically with the machine cycle.

Consistently repeatable tolerances of better than .001" and good surface finish are provided by the accurate, rigid, heavy-duty construction of the machine — including the heavily supported sliding tables which ride on hardened and ground ways and are accurately positioned against positive stops.

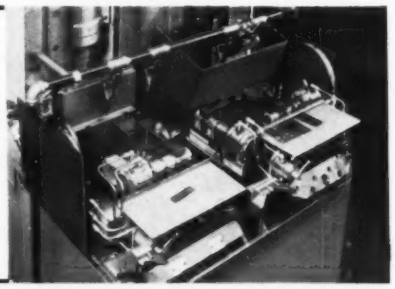
The wide open tooling area and standard table combinations makes it possible to tool basic machines for a wide variety of applications without the extra cost of machine modification. Thus the broad line of vertical and horizontal Sundstrand-American broaching machines makes it possible to give you *customized production methods with standard machines.*





Four operations are required on each part:

1. Straddle broach narrow sides
2. Broach keyway
3. Broach one end and key on wide side
4. Broach end with step



"Engineered Production Service FOR BROACHING

It takes all 3 for peak broaching performance

1 **Proper Broach Tool Design** — This logical first step in solving a broaching problem requires consideration of stock removal, length and width of cut, finish, tolerances, etc., so broach fixture and machine operate as a team.

2 **Specifying the Right Machine** — Production rate required, length and speed of stroke, floor space, and relationship with other production machinery are all considered before choosing the machine for a job.

3 **Efficient Fixturing** — This vital third link in the production chain enables production schedules to be met even with inexperienced operators because fixtures are provided with the skills "built in."

SUNDSTRAND

SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS

Division of SUNDSTRAND CORPORATION

This new bulletin describes the new line of Sundstrand 4-way convertible broaching machines for vertical push-down, surface, pull-down, and pull-up broaching. Ask for Bulletin No. 628-1.

June, 1961

For more data circle No. 819 on card at back of book.

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

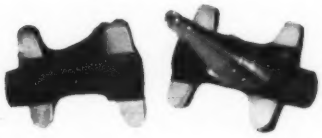
how to improve your milling methods with SUNDSTRAND "ENGINEERED PRODUCTION"

The design of a machine can be a production handicap if it can't be adapted to the production method. With Sundstrand "Engineered Production," method design comes first, machine design second. Rather than try to fit existing machine designs into milling methods, our engineers first determine the most economical milling method. They then apply the most economical machine design to suit this method. In some cases, standard Rigidmils suit the job at hand. In others, Rigidmils of unit construction are rearranged and modified to suit the method. Where neither of these are applicable, our engineers design entirely special machines for the job. Here are specific examples of each.

1 Standard Rigidmils with fixtures and tooling to suit your work

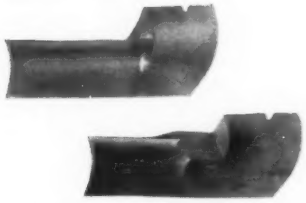
This standard Sundstrand Rigidmil with electronic tracer is used to slab mill the surfaces of many sizes of key and spring bars. A combination magnetic and clamp-type fixture holds two parts with fast adjustment for varying sizes. Templates are mounted on the front of the table for rapid changing. A selector switch converts the machine from tracing to straight milling using pre-set dogs for automatic cycles.

2 Rigidmils with special heads and tooling

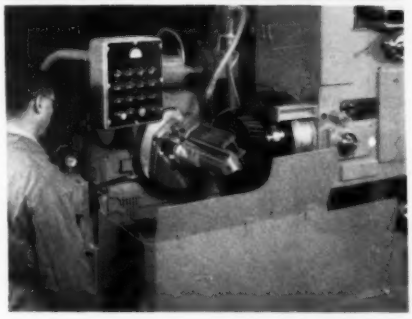


This C Model Sundstrand Rigidmil employs one right-hand head and one left-hand head on a single column to simultaneously straddle mill both sides of all four lugs on steering knuckles. Easily loaded fixtures are located at each end of the table. Through use of a standard two-way automatic table cycle, loading time is free. Production is approximately 65 pieces per hour at 80% efficiency.

3 Entirely special machines



This special machine face mills the area of blend between the air foil and blade root on various sizes and types of turbine blades. The part is held in a fixture mounted on a rotating cam which establishes the radius and tangent to the blade. A sine bar follower moves the part in and out to form the root contour angle. A completely automatic cycle is controlled by preset switches and dogs.



SUNDSTRAND

SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS

Division of SUNDSTRAND CORPORATION

The milling machines to improve your methods are described in Sundstrand Bulletin No. 628-2 available upon request. Write for your copy today.

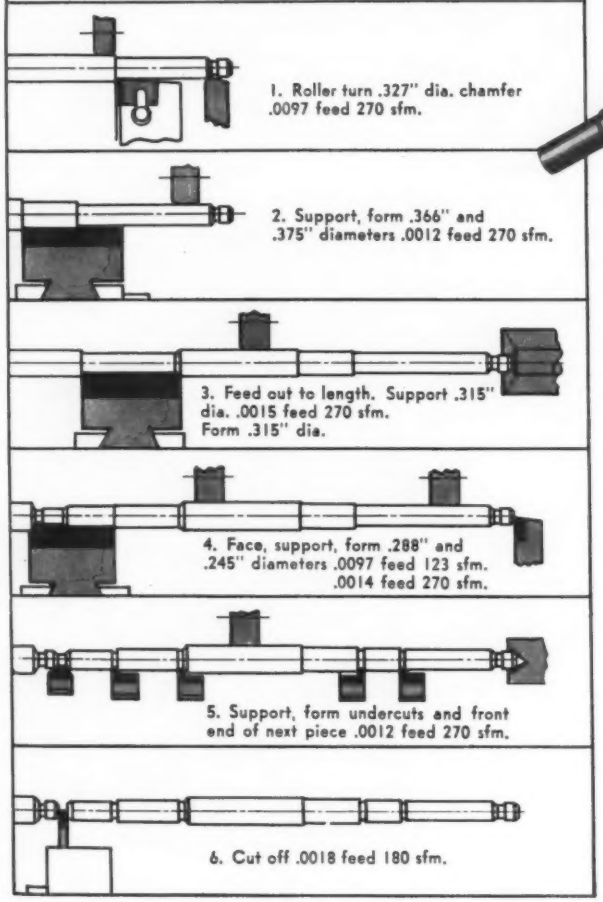
For more data circle No. 820 on card at back of book.

June, 1961

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

GREENLEE AIR-FEED AUTOMATICS BENEFIT "ELECTROLUX" FOUR WAYS . . .

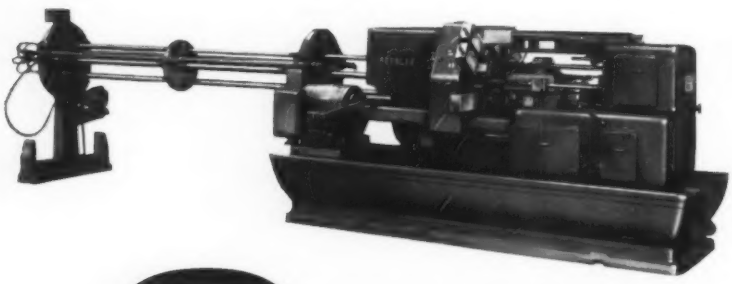
MACHINE . . . 1"-6 Automatic Bar Machine Air-Feed — Feedout on index and in 3rd position during machine cycle. TOOLING . . . Carbide Tipped MATERIAL . . . 1137 STOCK SIZE . . . 13/32" rd.	TOOL SLIDE STROKE . . 1-9/16" at .0097" feed. SPINDLE SPEED . . . 2540 rpm 270 sfm. MACHINE TIME . . . 5.8 seconds. ESTIMATED GROSS PRODUCTION . . . 620 per hour



1. Eliminate stock pushers . . .
2. Eliminate scoring of stock . . .
3. Reduce downtime during set-up . . .
4. Provide extra length feed-out . . .

The part is a 6-7/8" long armature shaft used in the "Electrolux" vacuum cleaner. It demonstrates how effectively Greenlee Air-Feed Automatics and carbide tooling can team-up to increase production and reduce costs. The shaft is machined from 13/32" S.A.E. 1137 steel at a gross production rate of 620 pieces per hour. Recommended cutting speed for high speed tooling is 120 sfm. The rate was boosted to 270 sfm with carbide-tipped tooling. Sequence of operations is shown at the left.

Note how the stock is partially fed out on the index and to its full length in the third position. This provides for the most effective tooling arrangement. Greenlee Air-Feed Automatics permit greater job versatility and assure added profits. See your Greenlee representative or send us a print of your high-cost problem-part.



Write for your copy of Catalog A-405

PRODUCTION MACHINERY

GREENLEE BROS. & CO.

SINCE 1863

1975 MASON AVENUE
ROCKFORD, ILLINOIS

COMMERCIAL CASTINGS

TRANSFER MACHINES • SPECIAL MACHINES • AUTOMATIC BAR MACHINES • WOODWORKING MACHINES AND TOOLS • DIE CASTING MACHINES • TRIM PRESSES • HYDRAULIC AND HAND TOOLS

For more data circle No. 821 on card at back of book.

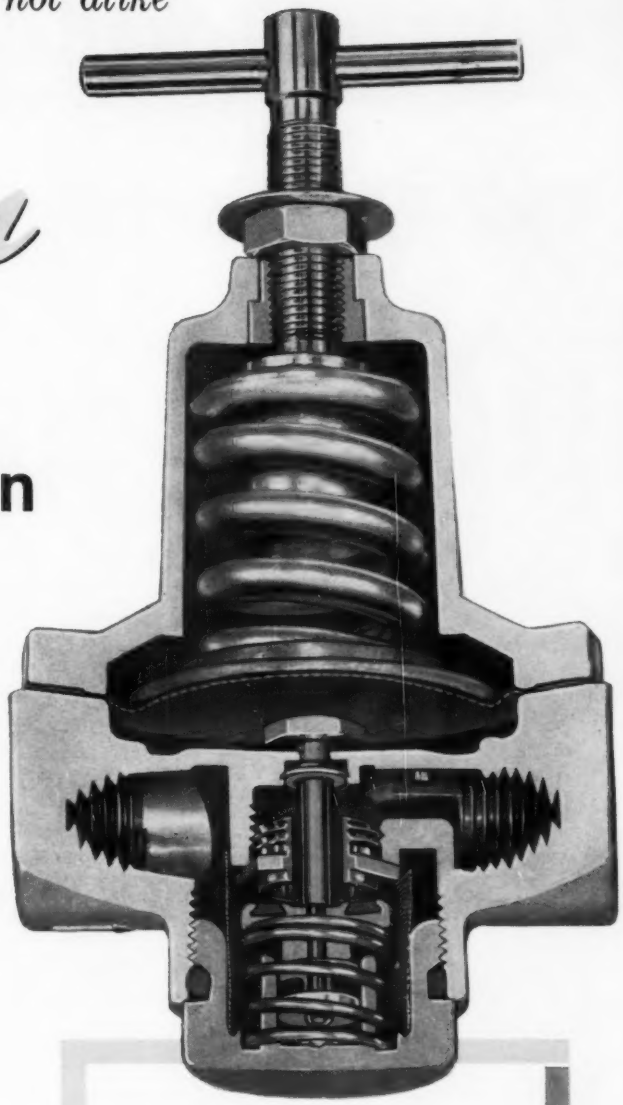
MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

All Pressure Regulators are not alike

Norgren

Floating Valve-Pin

A Norgren extra that assures leak-proof seating of the regulator valve



A tight, leak-proof seating of the valve is essential to the proper performance of a pressure regulator. Leakage and creep can be caused by improper alignment of the valve-pin, resulting in gouges and excessive wear on the valve seats.

To prevent this, Norgren Regulators are made with a floating valve-pin, eliminating critical alignment problems. The Norgren floating valve-pin is self-aligning, assuring positive seating of the valve. As a result, there is minimum wear on the valve seat, with increased service life and more dependable regulator performance.

Whatever your pressure regulation need, there is a Norgren Pressure Regulator designed for the job. Call your nearby Norgren Representative listed in your telephone directory—or write factory for literature showing complete Norgren Regulator line.

Norgren Pressure Regulators give you these important features:

Balanced Valve Construction—
improved regulator performance

Large Nylon-reinforced Synthetic Rubber Diaphragm—long service life

Baffle and Siphon Tube—
increased accuracy

Large Passages and Valve Openings—
large flow capacity

Easy servicing while still on fluid-line

Floating Valve-Pin—
assures better seating

FOUNDED IN 1926

C. A. NORGREN CO.

3419 SOUTH ELATI STREET • ENGLEWOOD, COLORADO

NEW

COLD OPERATING

ELECTROPERM Chucks

Combining the advantages of both electric and permanent magnetic chucks, this new cold operating chuck represents the ultimate in precision for large magnetic chucks. The chuck is only energized and deenergized electrically while permanent magnets do the actual holding during machinery operation. Energizing and deenergizing cycles are so short that heat and accompanying distortion are eliminated. The cold operating Electroperm Chuck is so stable dimensionally that it will hold the precision tolerances of the machine tool upon which it is mounted.

Write for Catalogue WPL60 showing the complete Walker line of demagnetizers, magnetic and vacuum chucks.

O.S. Walker
COMPANY, INC.
ROCKDALE ST., WORCESTER 6, MASS.

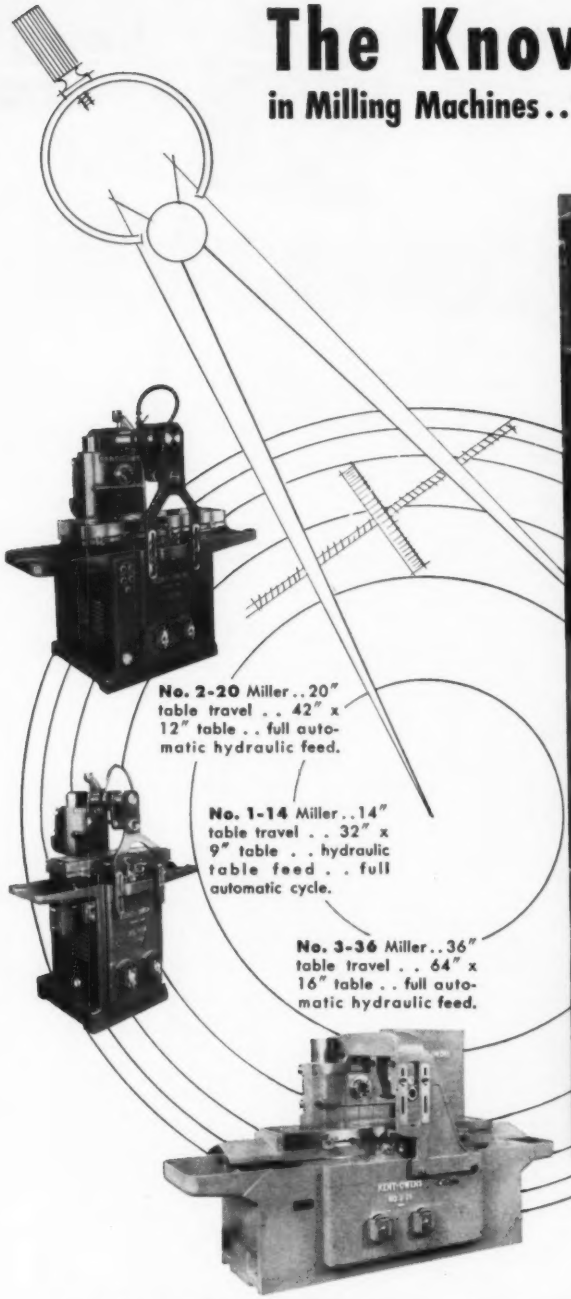
WALKER CERAMAX CHUCKS

Versatile Walker Ceramax Chucks featuring ultra-permanent ceramic magnets are successfully applied on grinders, millers, lathes, shapers and many other type machines. Powerful, rugged and stable, these permanent magnetic chucks can handle large heavy pieces or small thin stock with equal ease. The all steel top plate minimizes redressing and provides a long wearing precision work surface. Focused flux keeps the magnetism down near the top plate and away from the spindle and other machine parts. Alternating north and south poles of *equal* strength keep cutting tools demagnetized.

MILLING TURNING GRINDING

The Know-How Dimension

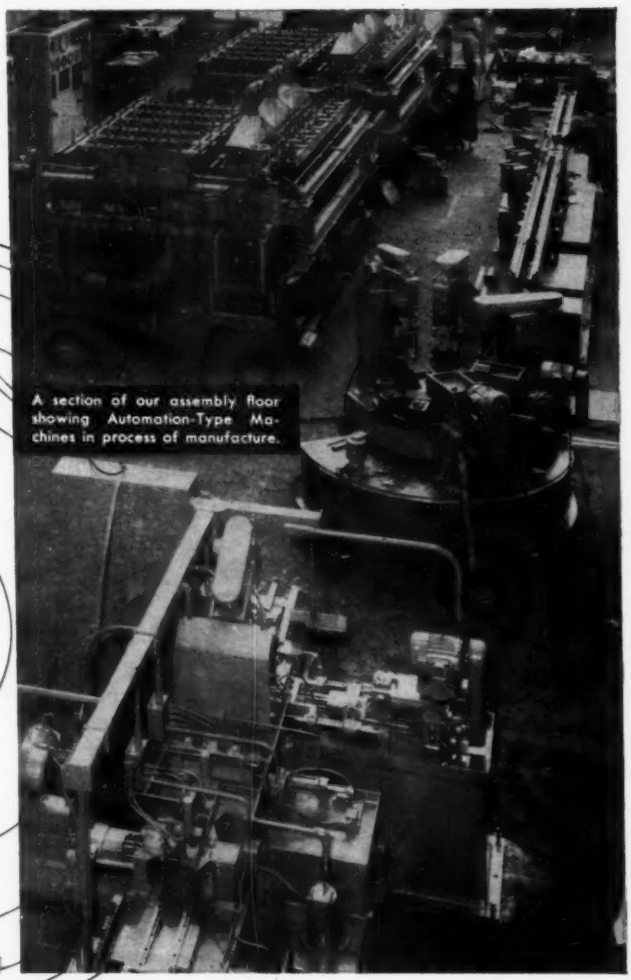
in Milling Machines . . Special Machinery . . Automation Equipment



No. 2-20 Miller . . 20″ table travel . . 42″ x 12″ table . . full automatic hydraulic feed.

No. 1-14 Miller . . 14″ table travel . . 32″ x 9″ table . . hydraulic table feed . . full automatic cycle.

No. 3-36 Miller . . 36″ table travel . . 64″ x 16″ table . . full automatic hydraulic feed.



A section of our assembly floor showing Automation-Type Machines in process of manufacture.

. . makes the difference in cutting costs . . increasing production

Know-How, born of years of experience, abetted by sound and imaginative design and quality manufacturing standards . . . is the reason why many of our customers, representing a wide and diversified coverage of industry, come back to us again and again for *answers* to their production problems.

When you are considering procurement of machinery for your milling needs . . . or seeking the solution to other production problems . . . you may wish to consider a Kent-Owens Milling Machine or a Special Machine designed for a distinctive and individual application. Contract Machine Building (customer designed equipment) is another of our specialties.

Write or call . . . Kent-Owens will be pleased to quote your requirements. Kent-Owens Machine Company, Toledo 10, Ohio.

KENT-OWENS *Designers and Builders of Milling Machines and Special Machinery*

- **Modernization Incentives**
- **Incentives Proposed**
- **Business Organizations Ponder**
- **World Machine Tool Summary Due**

Keeping up with Washington

Loring F. Overman

MANY of the machine tool industry's sales arguments favoring expansion and modernization of industrial plants have been written into the official record of the Eighty-Seventh Congress.

The writer—John F. Kennedy;

The script—the President's message on taxation;

The occasion—the Administration's first set of recommendations on tax policy.

Modernization Incentives

While all of the President's tax recommendations affect machine tool people in one way or another, principal interest lies with a section devoted to "Tax Incentives for Modernization and Expansion."

"The history of our economy," the President observed, "has been one of rising productivity, based on improvement in skills, advances in technology, and a growing supply of more efficient tools and equipment. It has also been the foundation of our leadership in world markets, even as we enjoyed the highest wage rates in the world.

"Forced to reconstruct after wartime devastation, our friends abroad now possess a modern industrial system helping to make them formidable competitors in world markets. If our own goods are to compete with foreign goods in price and quality, both at home and abroad, we shall need the most efficient plant and equipment.

Incentives Proposed

"Specifically, therefore, I recommend enactment of an investment tax incentive in the form of a tax credit of

"15 per cent of all new plant and equipment expenditures in excess of current depreciation allowances;

"6 per cent of such expenditures below this level but in excess of 50 per cent of depreciation allowances; with

"10 per cent on the first $5000 of new investment as a minimum credit.

"This credit would be taken as an offset against the firm's tax liability, up to an over-all limitation of 30 per cent in the reduction of that liability in any one year. It would be separate from and in addition to depreciation of the eligible new investment at cost. It would be available to individually owned businesses as well as corporate enterprises, and apply to eligible investment expenditures made after January 1 of this year."

Business Organizations Ponder

Business organizations which have been pressing for tax reforms registered a mixed reaction to the President's proposals.

Officials of the National Machine Tool Builders' Association reported plans for a poll of the entire membership to serve as a guide in presenting the industry viewpoint at the expected tax hearings. Preliminary returns indicated a feeling that the Administration's proposal is "a step in the right direction, and one that should be given a chance to be tried out." NMTBA people conceded, however, that the President's message will come in for a lot of "word picking" from many sides, including both industry and labor. It was thought that numerous changes would be debated before the recommendations became law.

One of his suggestions appeared to be completely at variance with the previous viewpoint of the Machinery and Allied Products Institute. The tax message proposed steps to phase out tax advantages enjoyed by domestic companies operating in foreign countries.

To prepare for hearings scheduled to start May 3, MAPI held special staff meetings in Washington on April 27 to re-examine previously stated positions. At that time no legislation had been introduced to implement details of the President's proposals.

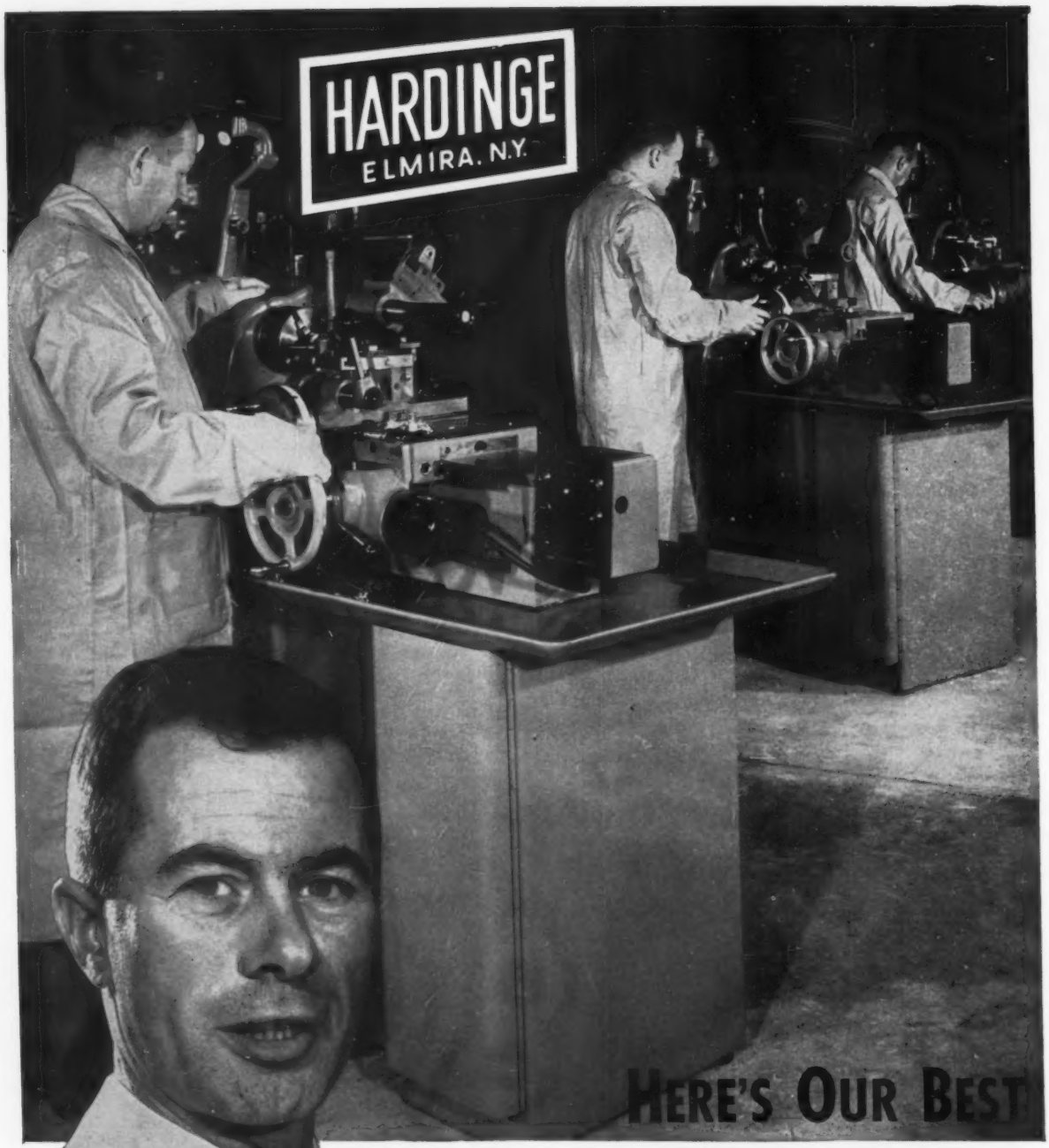
Comments at the United States Chamber of Commerce were being withheld until after the annual meeting. For many years both the U.S. Chamber and the National Association of Manufacturers have urged, in addition to short-range depreciation adjustments, a system of over-all tax reforms. As outlined in repeatedly introduced Herlong-Baker bills, corporate and individual income-tax rates would be reduced over a five-year period, estate and gift taxes would be reduced, and other inequities would be considered.

World Machine Tool Summary Due

A 200-page summary of world conditions affecting the machine tool industry is nearing completion by the Business and Defense Services Administration. Included will be tables showing machine tool production, exports, and imports by principal countries for the years 1955 through 1958. There will be breakdowns by types of machine, providing for the first time a government summary of how various countries buy and sell machine tools.

BDSA people working on the document promise it will be as complete for the machine tool industry as is "The U.S. Industrial Outlook for 1961," a 260-page booklet that summarizes ninety-one selected industries. This publication contains a fifty-page section discussing twenty-two machinery industries. The two-page section devoted to the machine tool outlook in the United States closes with the following conclusion:

"The machine tool industry views its outlook for 1961 as somewhat encouraging compared to the 1958-60 period, notwithstanding current unsettled conditions and the export-import picture. Shipments of cutting and forming type machine tools in the first half of 1961 are expected to approximate the level of the last half of 1960, an upturn of both shipments and new orders being anticipated in the second half of 1961. The total value of shipments of cutting and forming type machine tools in 1961 is estimated to be slightly higher than in 1960."



HERE'S OUR BEST INVESTMENT

HARDINGE machines for Super Precision and High Speed Production at low cost.

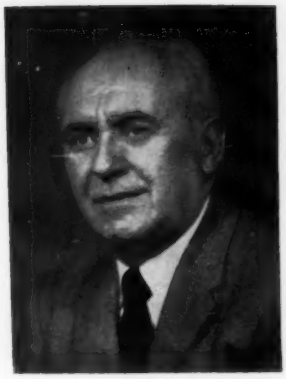
See the HARDINGE Sales Engineer for complete information and specifications.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

OFFICES IN PRINCIPAL CITIES. Export Office—269 Lafayette St., New York 12, N. Y.

Machinery

JUNE 1961



A Senator Reflects

RALPH E. FLANDERS belonged to the machine tool industry long before he became a prominent figure in public life. The chapters, therefore, which deal with the earlier years in his recent autobiography, *Senator from Vermont,* will be of greatest interest to the readers of MACHINERY.

At the age of sixteen, Mr. Flanders was bound out to Brown & Sharpe for a specified number of days that amounted to three years of full time. In the indenture, the concern agreed to teach him the art and practice of the machinist's trade. In his book, the Former Senator pays this tribute to his first employers: "To serve an apprenticeship at Brown and Sharpe's in those days was to receive the finest mechanical training that the world afforded. The requirements for output were high, but those for accuracy were supreme. That accuracy was the sum of many detailed requirements put together. No one of them could be slighted."

Following the conclusion of his apprenticeship, Mr. Flanders spent some years in the drafting departments of Brown & Sharpe, the Taft-Peirce Mfg. Co., Flather & Co., and the General Electric Co. During this period he commenced the practice of writing technical articles for publication in machine-shop magazines. He testifies that this writing made him better known and resulted in new opportunities in his business life.

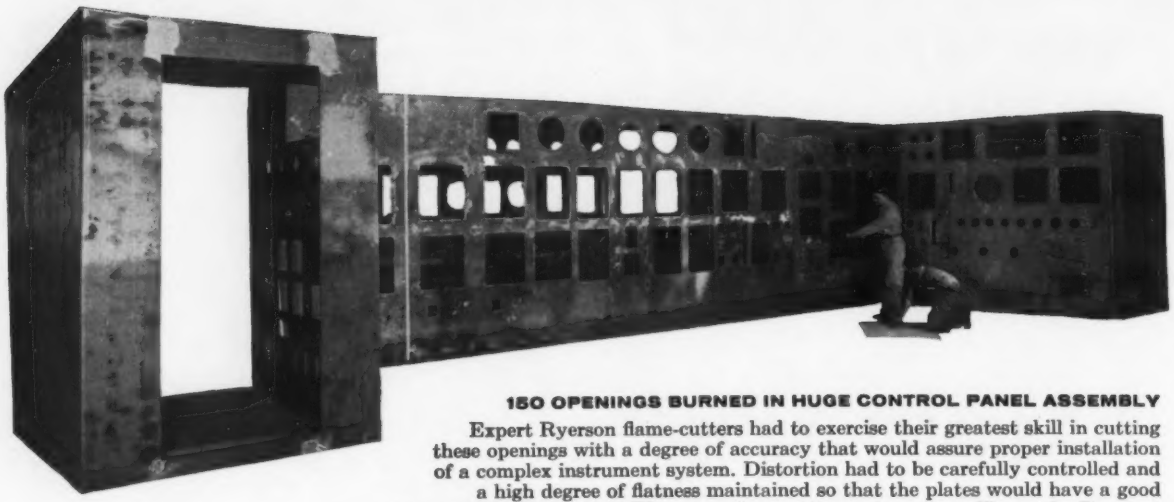
In fact, it lead to his becoming an associate editor on the staff of MACHINERY in the year 1905. Mr. Flanders writes: "This began five years of enthralling and constructive experience, without which my life would have been far less interesting." One whole chapter is devoted to his life as an editor. During this period he became acquainted throughout the machine tool industry with such prominent personages as Dr. Frederick W. Taylor, father of the application of high-speed steel to metal-cutting.

Before entering public life, Mr. Flanders served a term as president of the National Machine Tool Builders' Association and as president of the American Society of Mechanical Engineers. For his work in the field of engineering he received the Worcester Warner and Hoover medals. Degrees were conferred upon him by Stevens Institute and Dartmouth College.

Mr. Flanders achieved distinction in representing his native state of Vermont in the United States Senate for twelve years. It is, however, on the basis of his having been a member of the Fourth Estate on our editorial staff that MACHINERY felicitates Ralph E. Flanders as the book of his life is announced.

Charles O. Herb

EDITOR



150 OPENINGS BURNED IN HUGE CONTROL PANEL ASSEMBLY

Expert Ryerson flame-cutters had to exercise their greatest skill in cutting these openings with a degree of accuracy that would assure proper installation of a complex instrument system. Distortion had to be carefully controlled and a high degree of flatness maintained so that the plates would have a good appearance when painted. These exacting requirements were readily met by Ryerson.

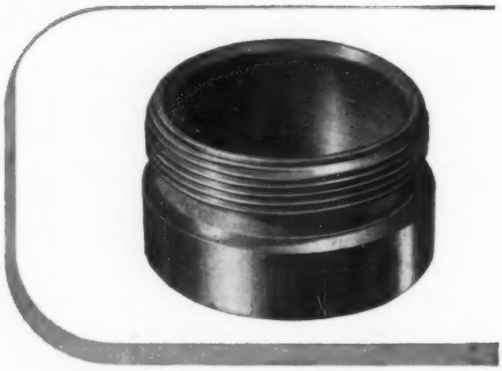
How METALOGICS* cools off the high-cost hot seat!

Here are two examples of how Ryerson Metalogics helps hundreds of companies save money, improve their products and cut costs.

Metalogics-trained Ryerson specialists help you value-analyze high-cost production problems—and give you unbiased recommendations on exactly the right steel, aluminum or plastic, plus the best methods of fabrication, to do the job.

Little wonder, then, that more and more companies across the country find the high-cost hot seat a little cooler after inviting a Ryerson man to value-analyze specific problems and come up with recommendations. Is your company taking full advantage of this unique service?

*Metalogics—the Ryerson science of giving optimum value for every purchasing dollar.



SUGGESTION ELIMINATES THREAD GALLING

Manufacturer made this special coupling of aluminum to gain the advantages of light weight, corrosion resistance and easy machining. But galling of threads presented a problem.

Following the recommendation of a Ryerson Metalogics specialist, the company hard-coated the parts by special low-temperature anodizing, which produced a surface hardness of Rockwell 70 C. Galling was eliminated, and corrosion resistance increased. One more example of cost-cutting technical help from Ryerson.

RYERSON METALOGICS

JOSEPH T. RYERSON & SON, INC., MEMBER OF THE INLAND STEEL FAMILY

STEEL • ALUMINUM • PLASTICS • METALWORKING MACHINERY

Machinery
Vol. 67 No. 10
June 1961

MACHINING THE ASTRO-METAL— PURE BERYLLIUM

LAURENCE W. COLLINS, Jr.
Associate Editor

The faster we go, the more we need low weight and high material strength at elevated temperatures. Metallic beryllium has about the same weight as magnesium, but it is much stronger than aluminum. Yet beryllium's strength holds up at temperatures that weaken aluminum

THE metal looks a little bluer than gray iron. In most machining operations it behaves like gray iron. But a man can pick up and walk away with a piece of metallic beryllium that he could not even budge if it were cast iron. Out on the fabrication floor one is struck by its cleanliness (heading illustration, next page) and the large, flexible hoses with nozzles reaching every cutting tool. These are vacuum ducts. Every tiny chip is care-

Table 1. Comparison of Physical Characteristics of Common Structural Metals

	Density (Pound-Inch³)	Melting Point Degree F.	Modulus of Elasticity (psi)	Tensile Strength* (psi)
Beryllium	0.067	2332	42,000,000	40,000 to 80,000
Aluminum	0.098	1220	9,000,000	15,000 to 80,000
Magnesium	0.063	1202	5,770,000	23,000 to 41,000
Steel	0.282	2750	29,000,000	50,000 to 290,000
Titanium	0.163	3035	16,800,000	60,000 to 200,000

*Estimates based on sheet-material comparison

Table 2. Nominal Mechanical Properties of Beryllium

	Vacuum Hot-Pressed Beryllium lock	Hot-Extruded
Ultimate Tensile Strength, psi	40,000	70,000
Yield Strength, 0.2 Per Cent Offset, psi	35,000	45,000
E Modulus, psi	42×10^6	42×10^6
Per Cent Elongation	1	10
Rockwell Hardness	B80	B90
Compression Yield Strength, 2 Per Cent Offset, psi	30,000	35,000

fully collected at the plant of the Beryllium Corporation's Nuclear Division in Hazelton, Pa. The reason is that the metal, worth about $35 a pound in the form of chips, can be reclaimed.

Certain properties of beryllium metal lend themselves well to critical functional parts of space vehicles, notably its high strength-to-weight ratio, even when heated to temperatures that cause aluminum and magnesium to lose a substantial part of their strength. Thus beryllium is attractive as a structural material, Tables 1 and 2.

Problem Still Exists

Beryllium, like any "new" metal or alloy, has its own technology and a set of individual problems in its handling. Development metallurgists have not yet learned how to make it ductile enough to be press-formed. It behaves like cast iron. Speeds, feeds, and chip loads in machining resemble those used in processing cast iron. The chips crumble. Tool life is generally a little longer on beryllium than on cast iron.

Until ten years ago few people knew the name beryllium in any connection except as an alloying element with copper. However, the characteristics of beryllium, when used as a moderator at atomic installations, brought the pure metal out of its laboratory-curiosity status. It is used as a shield in protecting personnel against destructive radiation in vehicles such as ships and submarines. Also it is expected to be vital in the same role in manned space vehicles if, as, and when one traverses through the Van Allen Radiation Belts in the earth's outer atmosphere, where the incidence of destructive radiation is reputed to be extremely high.

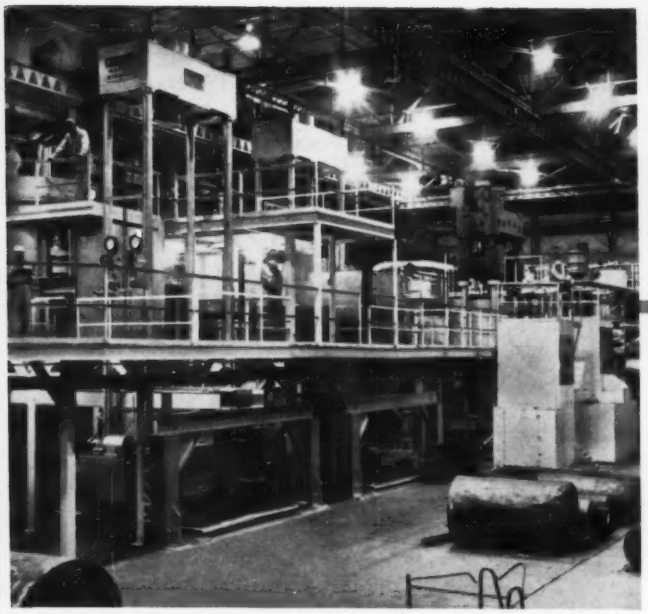
Many Steps from Ore to Machining Blanks

Metallic beryllium is produced by chemically processing the ore to remove impurities, and finally melting and pouring it into an ingot in a vacuum chamber. Cast ingots are coarse-grained, with directional characteristics, and thus not suitable for further fabricating into gyro gimbals and similar rocket guidance parts.

Fine-grained isotropic machining stock is made by a powder-metallurgy process utilizing hot-pressing techniques, Fig. 1. Cast ingots are machined into chips and the chips milled to powder. Chips are also collected from all machining operations and these are recycled into powder for compacting into more machining blanks. Great care is taken to prevent heating to temperatures high enough to cause formation of beryllium oxide.

Beryllium metal has about twice the value of silver; hence, every chip is salvaged. The company has a fair-sized machine shop (heading illustration) to furnish many products in rough-machined form to space and missile manufacturers.

An example of work done at this plant is a



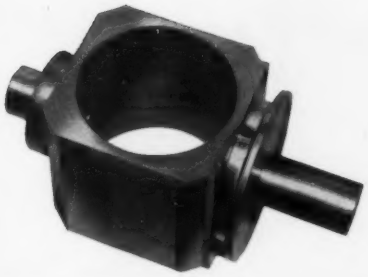


Fig. 1. (Left) The recovery of beryllium from the intermediate beads is expensive, involving the use of vacuum furnaces.

Fig. 2. (Above) Gimbal blank for a missile gyro is machined from the solid at the Beryllium Corporation plant. Chips and the trepanned center core can be saved and recycled for additional pressings.

gyro gimbal for a missile guidance system furnished premachined for General Electric Co.'s Pittsfield, Mass., works, Fig. 2. This part is machined from the solid. Where lathe turning cuts are made, throw-away or brazed carbide tools are used, usually with negative or neutral rakes, Fig. 3. Both Carboloy 885 and equivalent Kennametal grades have proved satisfactory. A cutting speed of 250 sfpm is the usual point of departure, but this may decrease. For roughing cuts, feed is in the range of 0.005 to 0.006 inch, with a 0.009- to 0.011-inch chip load (Fig. 3). Finish cuts are made with a 0.002-inch feed, yielding a surface finish of 8 to 10 micro-inches. Tools need no chip-breakers because chip formation is a brittle-fracture process. The work-surface burnishes somewhat under a light cut but does not work-harden. Excessive speed or high chip loading are likely to cause incipient cracks in the work-surface. These must be rejected lest the parts have low reliability. Spalling at ends is counteracted by beveling the corners prior to making the regular outside-diameter turning cuts.

Milling operations are similar to turning. Cutting is done at 250 sfpm and slower, with feeds at 0.009 to 0.012 for roughing and 0.005 to 0.006 for finish, Fig. 4. Carbide-tipped cutters have the greatest possible number of teeth to increase cutting rate. Chip disposal is no problem. Finishes of 35 micro-inches are average, and climb milling is used to prevent breakout at the end of a pass. For a final cut a light pass with a fly cutter will give a finish better than 35 micro-inches because beryllium does not smear like steel or aluminum.

Solid carbide and carbide-tipped drills are used. These are ground with a 125-degree included-angle lip geometry. The lip faces are ground neutral to reduce drill grab on the breakthrough. No coolant is used in any machining in order to avoid contamination of the chips. In other words, it is better to sacrifice tool life than to risk contamination of chips with coolants.

Metal Salvage and Oxidation—Factors Determining Cutting Techniques

The high cost of beryllium, the need for salvaging chips, and the requirement of preventing oxidation of the metal forced the company into some operations that would be unfeasible for anything but beryllium. For example, the cradle hole in the G-E gimbal has a diameter of 2.625 inches and a similar depth. It is vital to save as much metal as possible; therefore the hole is trepanned, instead of being bored, using electro-discharge machining by means of a 60-ampere Cincinnati Elektro-jet machine, Fig. 5. Practice is standard for EDM, even to the electrode. To machine this bore and salvage the largest possible core, the electrode is brass tubing with a wall 0.050 inch thick. Certain other electrodes are made of low-density-compacted tungsten, infiltrated with silver. The trepanning cut is made using 45 volts, 70 amperes, at 28 microfarads. Feed rate is 3 inches per hour,

Fig. 3. Beryllium is turned much the same as cast iron. The lathes are enclosed to keep the chips away from operators and off the floor.

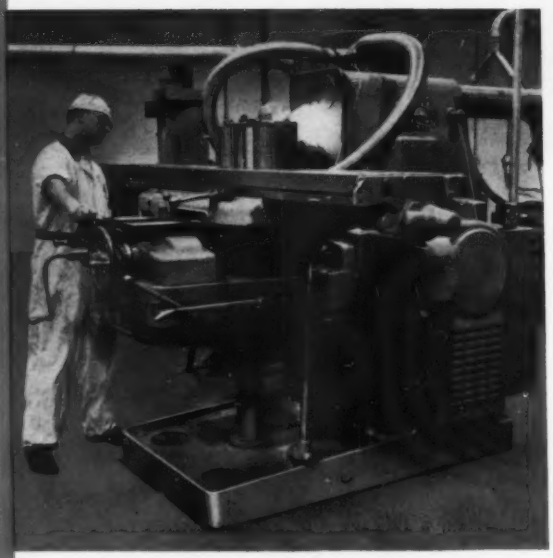


Fig. 4. Vacuum ducts close to milling cutters make chip collection no problem on facing operations.

Fig. 5. To save the center core and to prevent oxidation of chips, electro-discharge machining trepans a bore in the G-E gyro gimbal.

however, dimensions can be held to 0.0002 inch.

Because the work is immersed in dielectric oil during the electro-discharge trepanning operation, the swarf can be recovered because oxidation does not take place. The dielectric oil is a standard Cincinnati Milling Machine Co. product resembling transformer oil. Larger bores are trepanned in a Bullard vertical turret lathe, Fig. 6.

Beryllium missile components have proved satisfactory as a structural product. The material is stable, and machining tolerances are held without difficulty on a variety of parts, Fig. 7. Expansion of the metal under the influences of machining is similar to that of mild steel. A cutting tool which will remove 300 to 400 cubic inches of beryllium will have a life of 800 to 900 cubic inches on steel.

The Beryllium Corporation has found that normally good "housekeeping" practices are adequate for machining the commercial metal. The vacuum system, at 600 cubic feet per minute, is effective in keeping chips off the floor. As in any machining shop, operators are trained to avoid cuts and atmospheric dust. They are carefully instructed in the handling of the metal. The plant has a penetrating personnel protection program with integrated industrial hygiene and safety aspects to provide safe handling of a material which has received widespread publicity for its toxic characteristics.

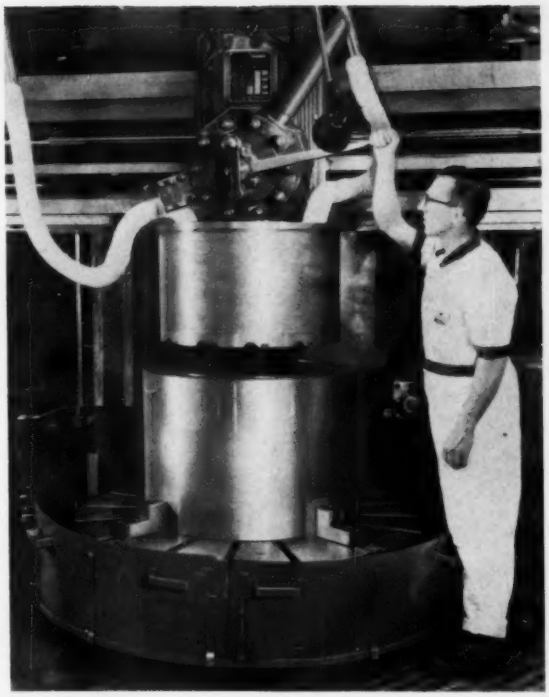


Fig. 6. A massive ring is made by a special carbide-tipped trepanning tool in this big Bullard vertical turret lathe.

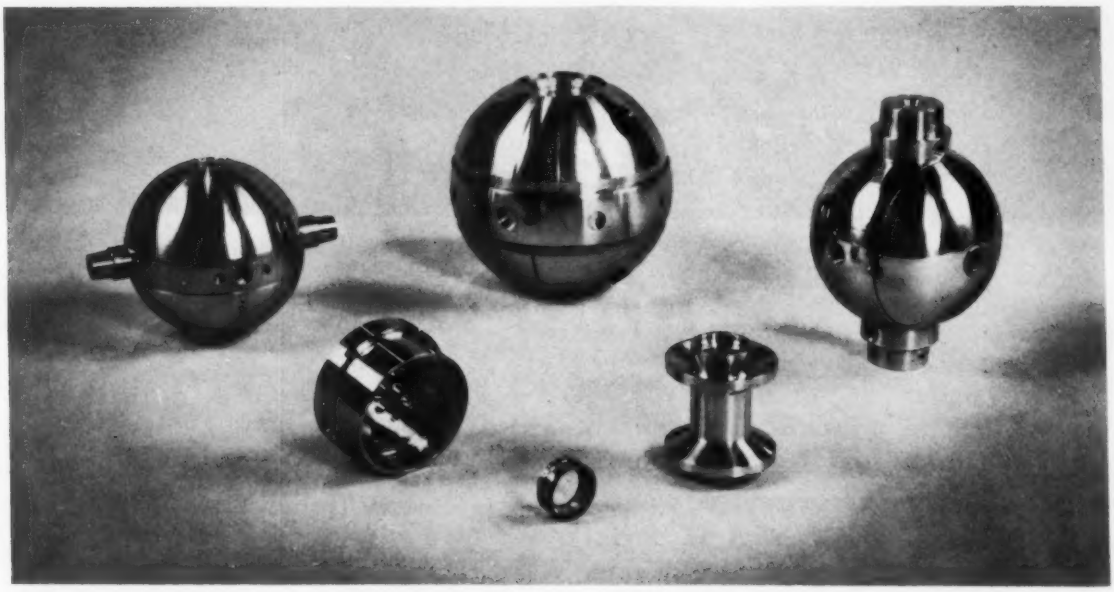
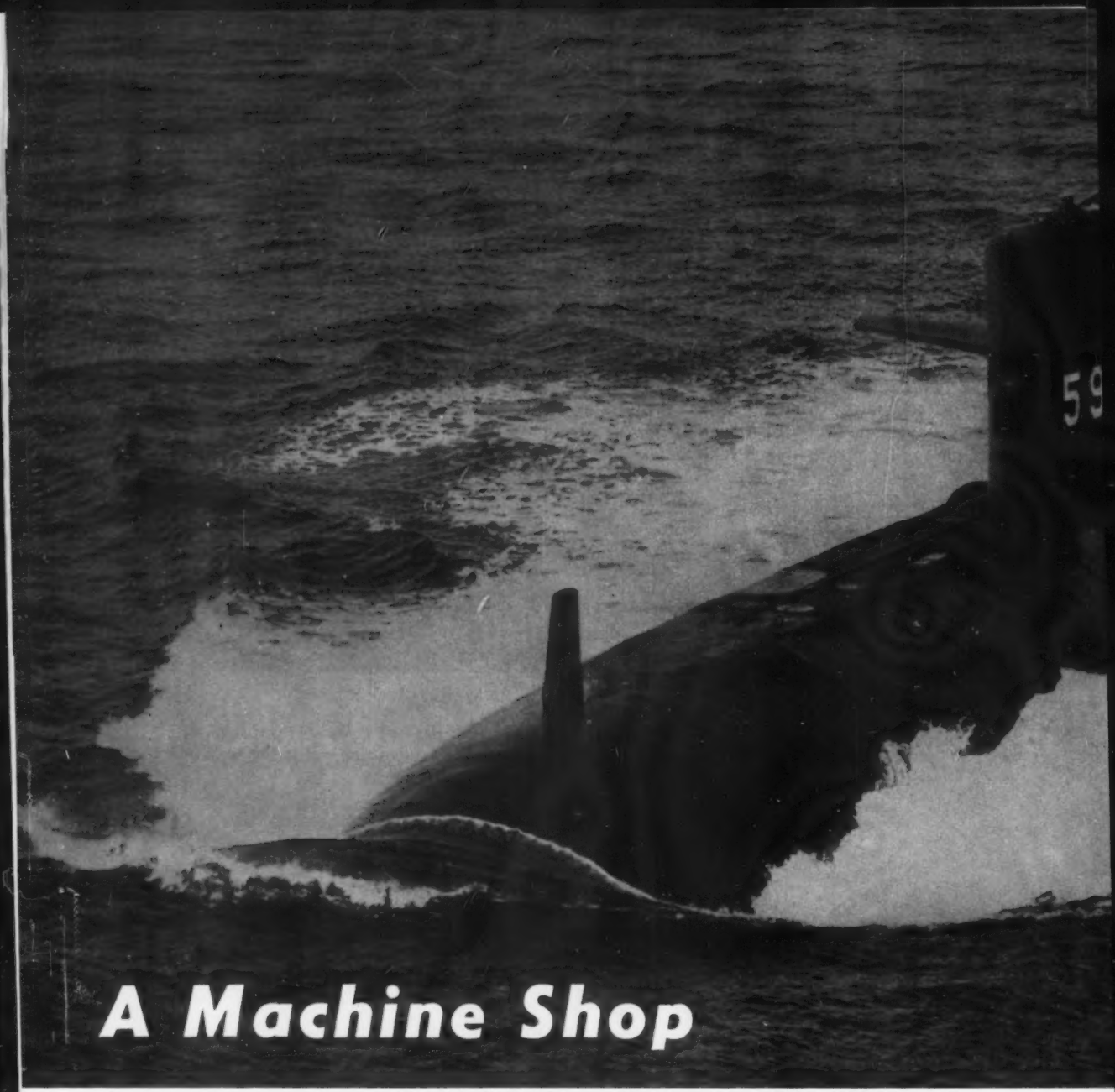


Fig. 7. Pure beryllium for gyro structures combines many desirable factors such as rigidity, mass stability, high heat conductivity, and low Poisson's ratio value.



A Machine Shop behind our Atomic

Geared for the ultimate in short-run production, Electric Boat Division's machine shop turns out more than its share of unique and contoured parts. An apprentice training program keeps the shop well supplied with highly skilled mechanics

TODAY, the nuclear-powered, Polaris-firing submarine is one of the greatest deterrents to all-out atomic war in America's arsenal for defense. This amazing weapon is capable of delivering unbelievable destruction—a single submarine can carry more firepower than was actually exploded in all of World War II. In contrast, these vessels have performed a number of "impossible" explorations and scientific feats with significant ap-

HAROLD W. BREDIN
Associate Editor

Submarines

plication for the peacetime benefit of mankind. Thus, regardless of its role, the atomic submarine is destined to play an important part in shaping the course of events to come.

For the past nine years, the exacting task of building nuclear submarines has been the major activity at the Electric Boat Division of General Dynamics Corporation, Groton, Conn. This company has built nine atomic submarines to date. The nation's fourteenth operational nuclear submarine, Tullibee, is seen in the heading illustration as it appeared during initial sea trials.

Making parts for nuclear submarines is not what one could normally call a high-production activity. This is particularly evident in the company's machine shop, which is essentially a "glorified" job shop specifically geared for short-run operation. A statistical study of the actual work processed during a single year in this shop showed startling results. On an average there were seven different parts to a bill of material and 10,000 bills of material per year. These 70,000 items varied in quantity from 1 to 100 parts. But the

average quantity of parts per item was only a little over three pieces when nuts, bolts, and similar items were neglected.

Although the majority of parts that pass through the shop are straightforward in design (taking into account that the work is of a shipbuilding nature), there is a considerable amount of unique and contour machining being performed. For this reason the shop is equipped with a more than average number of tracer-controlled machine tools. Many of the contoured parts require a high-degree of accuracy, as they are directly concerned with the watertight integrity of the submarines.

Rotating spherical-shaped members used in ball valves are an example. These are made of copper-nickel alloy in sizes ranging between 5/8 and (approximately) 18 inches in diameter. They are turned on tracer-controlled lathes to an accuracy of plus or minus 0.001 inch and then polished to an 8-micro-inch finish.

Another typical tracer-controlled operation, illustrated in the heading insert, is the contour planning of submarine antenna-mast fairings. This is accomplished on a Rockford hydraulic shaper-planer equipped with a Kopy-Kat duplicator attachment. The machining of the fairing surfaces is a one-dimension type contouring operation for which three templates are required. One template each is used for the leading edge and the trailing edge, whereas only a single template is necessary to machine the two side surfaces. This is done by reversing the template.

The long work-piece is made of aluminum and consists of three extrusions welded together. In this case, the cutting speed is necessarily low (about 150 fpm), since the tool must be stopped before hitting a flange at the end of the cut. An undercut is provided in front of the flange to accommodate and prevent damage to the high-speed-steel cutter. On other antenna masts, where a flange is not necessary, cutting speeds of well over 200 fpm are employed. The part is completed in seven separate setups, and the shape is held to within a few thousandths of an inch. Since a plastic coating material is placed over a portion of the mast, it is undercut by using a tool with a point slightly larger in diameter than the tracer stylus.

Several sizes of antenna-mast fairings are cut with the same template by compensating for the rather small dimensional differentials through the use of various cutter-to-stylus diameter ratios. The machine, has a rated size of 42 by 42 inches by a length of 26 feet and has one side head and two rail heads, one of which is tracer-controlled. The tracer control is provided with a safety device that, in the event of power failure in the separate tracer hydraulic system, will retract the tool-head to the uppermost position, preventing

Fig. 1. This numerically controlled drilling machine is being used to center-drill, drill, and spot-face ten holes in a bronze gear case. Depth settings are made on the drum at the left of the drill head.

Fig. 2. Plastic tape, punched in a direct-reading decimal code, is shown here being adjusted in the tape reader by the operator prior to machining of the gear case illustrated in Fig. 1.

damage to the work. In the illustration, the operator is shown machining the contour of one of the two side fairing surfaces.

A third unique contouring job is the cutting of a circular gasket groove in a roller box for a torpedo tube. The work-piece is a curved member of large radius that fits externally on a torpedo tube. The oddly shaped groove, which is curved on two axes, is cut on a horizontal boring mill that has been altered for the purpose. The boring-bar is equipped with a follower and weight loaded in one direction to allow the follower to rotate in contact with a fixed cam having the shape of the work-piece. In machining the groove, the cutter is set to rotate in the proper circular path, and the cam moves the bar and cutter in and out according to the curved shape of the part.

One piece of numerically controlled equipment which is in continual operation and used for many types of work is a Hillyer tape-controlled drilling machine (Fig. 1). A feature of the arrangement is that an operator can punch his own tape with a direct-reading decimal code in accordance with the plan dimensions. This is done by means of the special punching device shown to the left of the control panel in Fig. 2. The tape reader, located above the control panel, is seen being inspected by the operator. A 4-inch wide plastic tape is employed. In use, the table moves forward and backward and the drilling head left to right in response to the digital information punched on the tape. The operator simply inserts the tool and pushes the start button for each cycle. Accuracy of positioning is within 0.001 inch per foot. Quick-change tool-holders, which simplify cutter positioning, are held in a special tool rack seen at the lower left in Fig. 2. Removal of the wrong tool-holder from the rack will prevent the machine from going through the next machining cycle when the restart button is punched.

The part shown set up in the machine is a bronze gear case. Ten holes in this part on a 14 1/2-inch bolt circle were center-drilled, then drilled through with a 9/32-inch drill, and spot-faced 5/8 inches in diameter—all under tape control. Cycle speed is determined by the operation. Center drilling, for example, required two minutes. Depth of cut is set manually on the depth-control drum seen to the left of the drill-head in Fig. 1. This equipment has eliminated the need for much layout work and many jigs. Location of the part on the work-table is simplified by a zero-point setting adjustment that permits the zero point of both axes to be relocated to any position on or off the work-table.

Fifteen 0.200- by 0.200-inch grooves in a cop-

Fig. 3. Engine lathe, rebuilt to have a 100-inch swing, is used to machine a square five-entry thread on the upper end of a Polaris missile tube. Roving inspector is checking the part.

Fig. 4. Close-up view of the thread-cutting operation shown in Fig. 3. Three sets of five gang tools are used to complete the thread.

per heat-exchange element were recently required to be cut in the shape of spirals of Archimedes having a 4-inch lead. Although this is a simple contour to produce on a milling machine by gearing a turntable to the machine table feed, the part design points out the variety of work that is commonplace in the shop.

The heart of such a versatile operation in the plant is well-trained people. To guarantee a continuous supply of mechanics solidly grounded in basic technical principles and skilled in machine operation, the company conducts a four-year apprentice training program into which a new man is inducted every two months. The program is extremely comprehensive and provides for a certain length of training time at each basic machine and function in the shop. Considering that for the majority of jobs setup requires more time than the actual machining, none but first-class machinists can perform satisfactorily.

A second feature which seems to stand out at the plant is the many machines which have been rebuilt to accommodate larger-size parts. A typical example of this is in the cutting of the threads (Figs. 3 and 4) on a Polaris missile tube. The 30-foot long engine lathe used for this operation has been built-up from a 60-inch swing to one of 100 inches. A five-entry, 1-inch pitch, square thread is cut on the nickel-copper alloy flange section at the upper end of the missile tube. The threads are cut simultaneously with five ganged cutters at a lathe spindle speed of 2 to 4 rpm. Three sets of tools are used for the entire operation, the first set consisting of solid, 5/16-inch wide cutters for roughing. The second, 7/16-inch wide, set and the finishing set are relieved at the

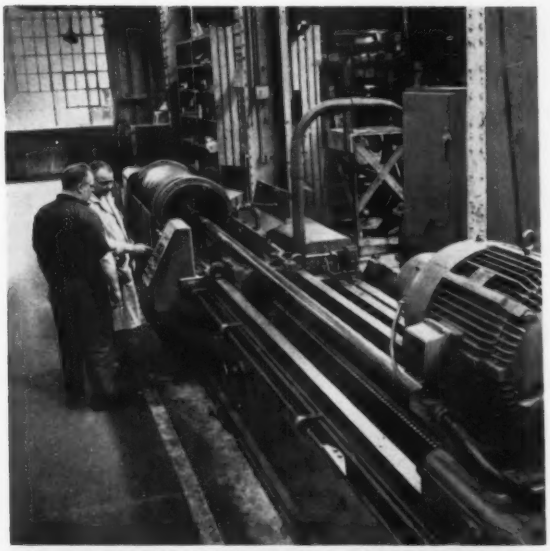


Fig. 5. Cylinder, 8 feet long with 23-inch diameter bore, being finished on a modified horizontal honing machine.

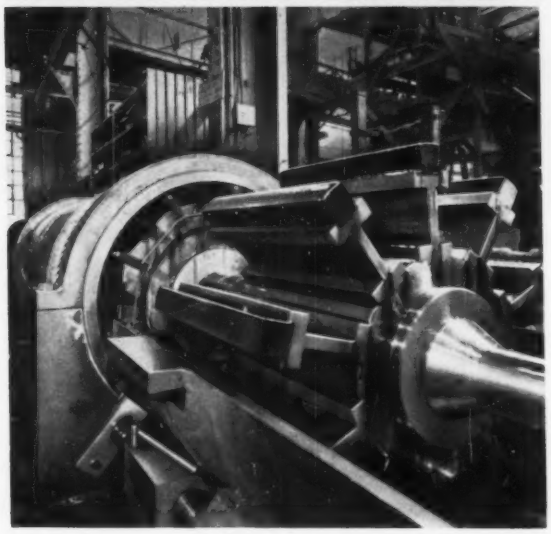


Fig. 6. Special honing tool used on the 23-inch diameter cylinder bore (Fig. 5) is seen here close-up. A 16-micro-inch surface finish was achieved.

center of the front edge. A 63-micro-inch finish is required, and the top edges of the threads are rounded slightly in the final cuts.

In one case, a 23-inch diameter, nickel-copper alloy cylinder 8 feet long was honed on a modified BarnesdriL horizontal honing machine originally built to hone bores up to 6 inches in diameter. The bore diameters that can now be accommodated are from 1 5/8 to 16 inches and from 17 to 23 inches. Lengths up to 21 feet can be handled. The 23-inch cylinder was honed with grits ranging from 120 size for roughing to 320 for polishing. A 16-micro-inch finish was achieved. Rotational speeds (about 20 rpm) and reciprocating speeds of the hone were varied to maintain a favorable cross-hatch pattern. A slower reciprocating speed is used for polishing than for roughing. Three views of the operation are shown in Figs. 5, 6, and 7. For lubrication, a medium to heavy, sulphurized oil is employed.

The drilling of bolt holes in flanges for valves and other components is an everyday task in many shops. At Electric Boat, however, with the variety of part sizes and configurations combined with short-run-operation, the amount of tooling necessary in the form of jigs and fixtures becomes a problem. To alleviate this situation and improve the quality of work, a Lapointe Rotomatic positioner indexing machine is used in conjunction with a Carlton radial drill for accurately drilling bolt holes without a jig.

In Fig. 8, a copper-nickel valve body is seen in the process of being drilled on this equipment for twenty-two bolt holes, 1 5/16 inches in diameter, on a 19 1/2-inch pitch-circle diameter. The rotary table is 36 inches in diameter and can be auto-

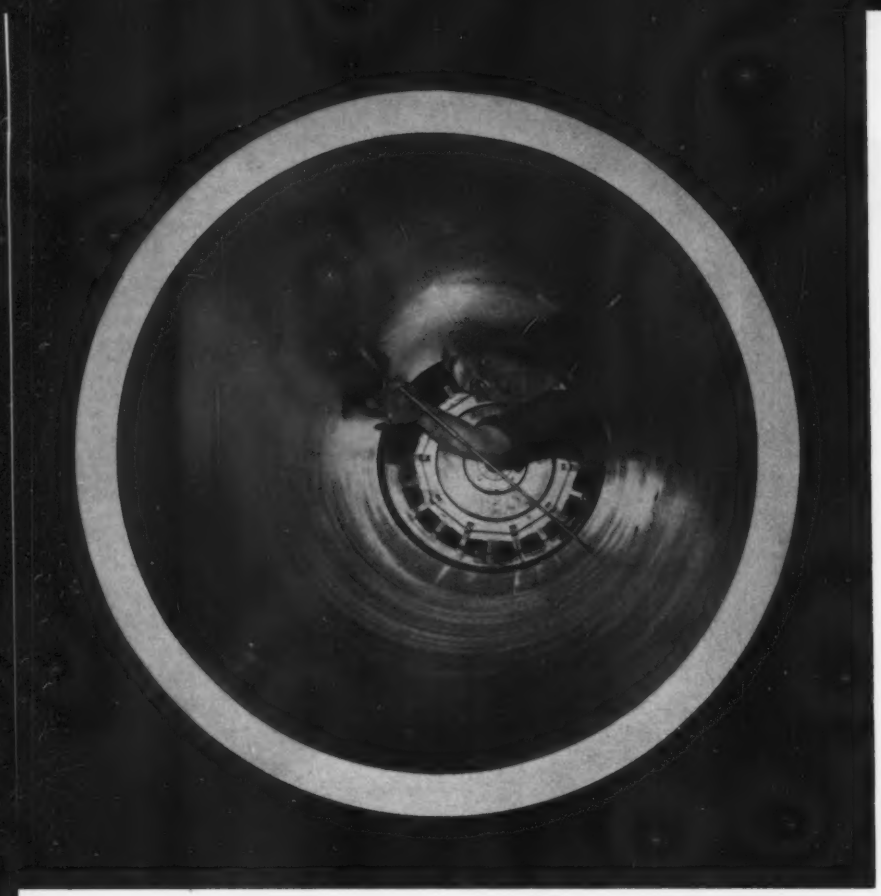


Fig. 7. Checking the size and finish of the cylinder bore after the operation. Parts up to 21 feet long can be honed on the modified machine.

matically positioned to within 5 seconds of arc by push-button operation. (A 5-seconds-of-arc error on a 19 1/2-inch diameter is approximately 0.00024 inch). The change-gear arrangement used in this particular setup permits indexing to any number of divisions from 2 to 120 in automatic operation, and an infinite number when manually indexed. The jig, which is seen leaning against the work-piece in the illustration, is of the type formerly required for this operation. In this application, parts weighing up to 5 tons are indexed automatically on the table without loss of accuracy.

A spectacular job was completed on short notice for the Atomic Energy Commission. It consisted of machining a considerable number of huge plates (Fig. 9)—35 feet long, 35 inches wide, and 1 1/16 inches thick—of commercially pure nickel. They had to be machined perfectly flat with a minimum thickness of 7/8 inch. After several experiments, the most effective method was found to be by face milling, using a high-speed-steel cutter. The plates were machined on an Ingersoll planer-mill equipped with a table only 16 feet long. A large number of blind holes also had to be drilled and tapped. Tapping of the nickel was found to be efficiently done with gun type taps, using Lasupar, a product of the Gulf Oil Co., as a lubricant.

One of the many larger jobs handled by the shop is seen in Fig. 10. This huge structure is the framework for a universal submarine simulator which is invaluable for training submarine personnel. In the illustration, a bearing surface at the top of the frame has just been finished on a large Sellers boring and milling machine.

Quick-change tool-holders are favored for use in machines such as horizontal boring mills, radial drills, and some milling machines. Since these cutters return a tool to exactly the same position each time, a special turret stop has been developed for mounting on the bar of horizontal boring mills to allow quick repositioning of the bar (and the tool) for repeat operations on parts.

Insert-tooth milling cutters have also come into much use. For example, eight-tooth Futurmill cutters with 6-inch diameter bodies and heavy-duty Grade 370 Carboloy indexable inserts with negative rake are being employed to cut nickel-copper alloy at feeds of 30 ipm and bronze at 50 ipm.

Every part is given 100 per cent final inspection, and first-piece inspection is performed for every operation. Large work-pieces are checked by roving inspectors on constant duty throughout the shop. Many parts are of such a large nature that only optical inspection can be employed to check alignments.

Fig. 8. (Right) Jigless drilling of bolt holes in this copper-nickel valve body is simplified by the power-indexing rotary table. Positioning of the work-piece is accurate to within 5 seconds of arc. Jigs of the type seen leaning against the valve body were formerly used.

Fig. 9. (Left) One of a number of large plates (35 feet long) made of commercially pure nickel that were machined flat on a 16-foot planer-mill. Work was special for the Atomic Energy Commission at Oak Ridge.

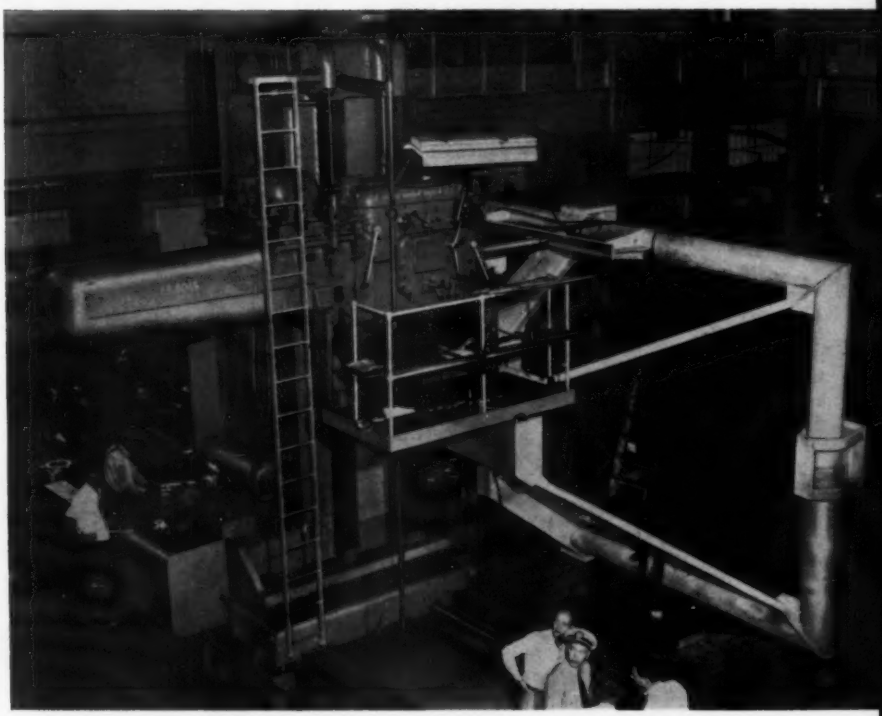


Fig. 10. The milling of bearing surfaces on this huge framework for a submarine simulator is typical of the one-of-a-kind machining performed in the shop.

Delicate gastight bellows and diaphragms can now be assembled from stainless foil as thin as 0.001 inch. Using the proper current control and a modified bench-model spot welder, an atomic laboratory produces a serviceable product at low capital expense

W. A. OWCZARSKI
and
R. E. BEACH
Knolls Atomic Power Laboratory
Schenectady, N. Y.

SEAM-WELDING STAINLESS-STEEL FOIL

SEAM WELDING of very thin sheet differs little in principle from welding normal-thickness metals. By "thin sheet" is meant metal foils of 0.001 to 0.005 inch in thickness. There is, however, a definite need for equipment which can provide the precision and control necessary for producing quality welds. This precision is critical in the fabrication of seam-welded gastight seals, such as are used on bellows and diaphragms.

There is a great abundance of adequate equipment available commercially for spot-welding sheet of this thickness. In particular, capacitor-discharge power supplies and foot-operated bench welding heads of many kinds can be purchased at relatively low cost. Alternating-current power sources are also available with synchronous timers. These can be used for spot-welding thin sheet effectively. However, a definite scarcity of inexpensive seam-welding equipment exists.

The problem of fabricating airtight containers from 0.003-inch AISI Type 304 stainless-steel sheet highlighted this shortage to the welding development group at the Knolls Atomic Power Laboratory, which is operated by the General Electric Co. for the United States Atomic Energy Commission. The project under development required several lap-seam joints which formed the container. At that time there was no equipment in the laboratory small enough to handle this delicate seam-welding assembly. The cost of a new installation was far too high in proportion to the small number of components to be made.

The problem was resolved in a relatively simple and surprisingly inexpensive way. The solution was effected by modifying a bench-model spot welder head so that it could perform as a seam welder. To maintain the usefulness of the head as a spot welder, all modifications were carried out without machining the original head itself. The existing head, shown in Fig. 1, was pedal-operated and was capable of providing up

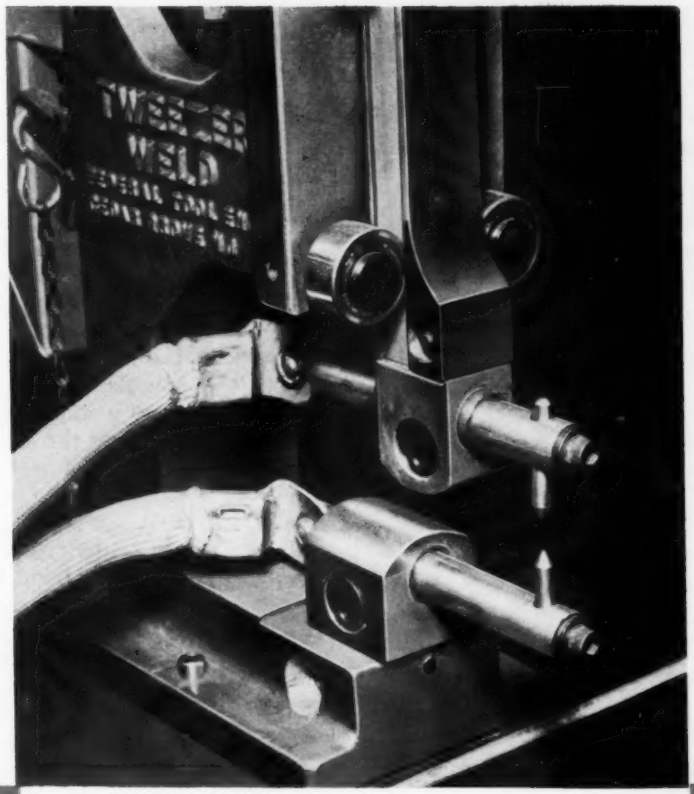


Fig. 1. Original bench-model spot welder was a Tweezer Weld unit built by Federal Tool Engineering Co. of Cedar Grove, N. J.

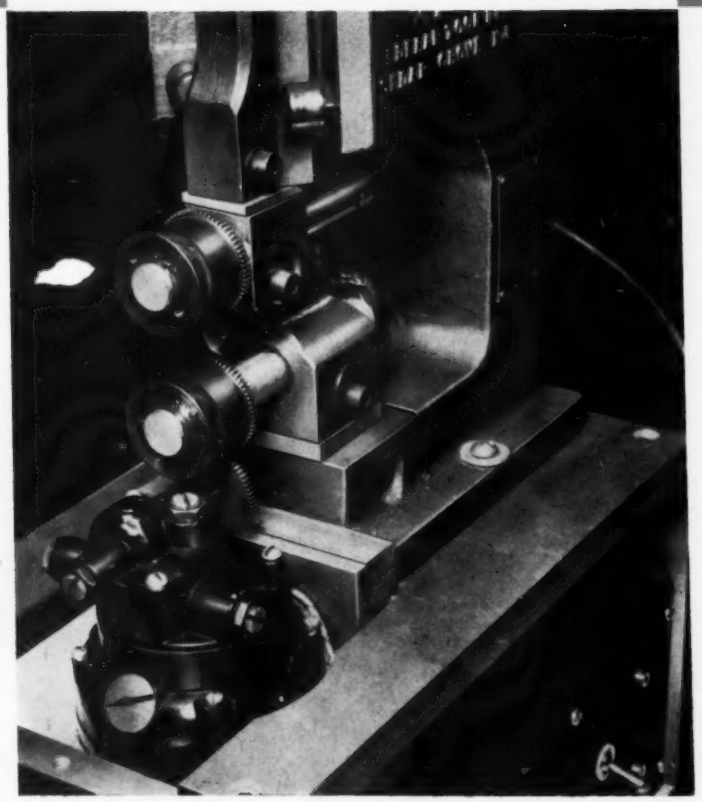


Fig. 2. Spot welder converted to seam welding is a machine tooled for joining bellows seams with "home-built" electrode wheels and a drive.

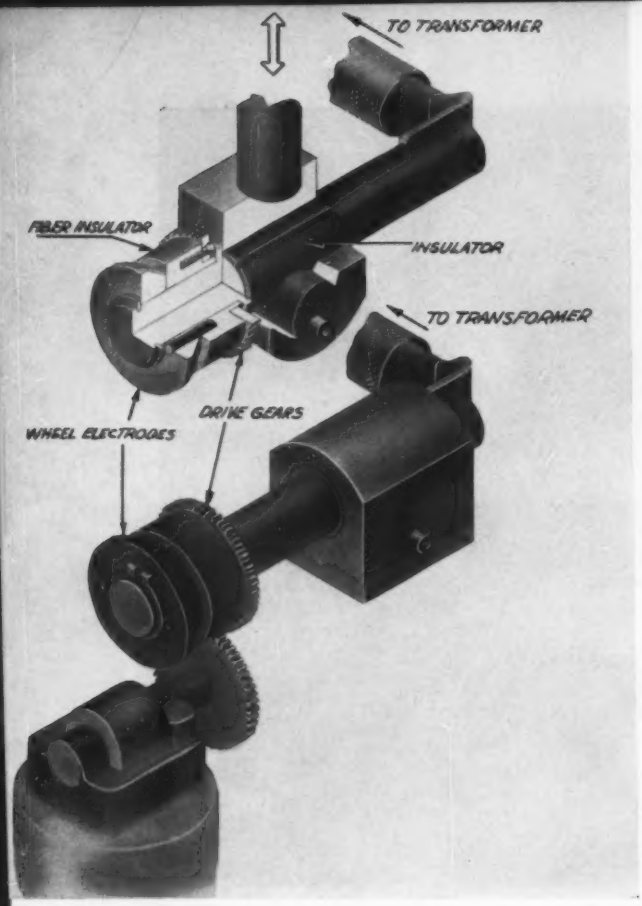


Fig. 3. Cutaway view of seam-welding electrode wheels and small, geared driving mechanism.

to 100 pounds of electrode force from a built-in spring mechanism. This force was adjustable continuously by means of a sliding fulcrum in the spring system.

To effect the modification, the entire head was first attached to a sturdy aluminum frame base, Fig. 2, which also housed the drive motor for the seam-weld electrode wheels. The drive used for this purpose had a direct-current motor which had a gear-box attached for speed reduction. The speed of the motor, and hence the revolutions per minute of the output shaft, was adjustable by a variable-voltage input to the motor. This was provided with a standard electronic direct-current power supply that could be adjusted to feed from 10 to 120 volts to the motor windings. The range of electrode wheel speeds thus obtainable was 1 to 5 rpm.

The electrode arms of the spot welder were replaced by similar shafts machined from RWMA Class II copper alloy. These were designed as axles to accommodate opposing seam-welding electrode wheels of 1 1/2-inch diameter. The seam-weld wheels, Fig. 3, were machined with a 1/16-inch face. The 1/16-inch welding surfaces were made with a 2-inch radius curvature. This type of contoured wheel surface is commonly used in larger seam-weld wheels. The purpose of the contour is to help maintain uniform pressure between the wheels during welding.

The wheels were slip fits over their shafts; and since the load on the wheels was fairly light, they were able to turn freely. As an aid to lubrication, a thin film of high-conductivity grease was used on the shaft bearing surfaces. The wheels and shafts were insulated from the drive gears which were also mounted on each shaft. The gears were the means of providing a positive drive to both wheels. The drive is critically important for light-gage work. If the two electrode wheels do not rotate at the same speed the resulting parts will definitely curl. Curling can only be prevented by rigid fixturing of the part, which is quite expensive. However, fixturing may not entirely solve the tendency to curling. And fixturing of the work can cause high shear forces at the weld line, also undesirable.

With the wheels and rotation speeds available in the lower gear-box, the range of surface-welding speeds obtainable with this apparatus was 5 to 20 ipm. This range was sufficiently wide for the material thicknesses welded. As the pictures show, the differences in the converted head are not complex, but they are effective.

The weld current and sequence timing for the welding were provided by a transformer and electronic sequence timer. These were "cannibalized" from another seam welder. By simply running copper busses to the upper and lower platens of a larger seam welder the necessary weld power was easily obtained. The control panel of this machine had a synchronous timer which had conventional seam-weld functions available. The controller was accurate to one cycle of weld time.

Fig. 4. Match heads, sealed within test coupon, ignite when heated and puff sample into a pillow.

It provided the electrical precision to complement the mechanical exactness of the head.

Thus assembled, the modified head was ready to seam-weld the 0.003-inch stainless-steel assemblies. Other materials, such as carbon steel, brass, and platinum, were also successfully seam-welded in thicknesses ranging from 0.002 to 0.006 inch.

The 0.003-inch stainless-steel foil offers an example of the quality welding of which this apparatus is capable. Because the surface finish of a sample is so important, surface preparation for welding is critical. Inconsistent surface preparation tends to result in erratic welding. The Type 304 stainless steel used had a fine, cold-rolled finish. However, before welding, the surface was cleaned of foreign matter by rinsing in acetone, thoroughly washing in detergent, rinsing again in water, and drying. Other materials may have oxides or more tenacious surface contaminants and would have to be acid-etched to obtain the optimum results.

To determine weld quality, two test methods were used: sectioning for microscopic examination, and the "pillow test." The pillow test is a simple means of finding out if a weld is leak-tight. This test consisted of seam-welding two square sheets of material together along the edges of their four sides. The overlapping seam welds formed an enclosure which was leak-tight if the welds were not porous. The coupon size for this thin sheet was about 2 inches square. After three sides of the pillow coupons were welded, one or two lucifer match heads were placed between the foil sheets; then the fourth side was sealed. By heating the coupon carefully, the match heads ignited, releasing a large volume of gas. Expansion inflated the coupons, which then resembled a pillow. Any leaks in the seam welds were readily detected by the pungent odor. A sound pillow simply bubbled up like the coupon seen in Fig. 4.

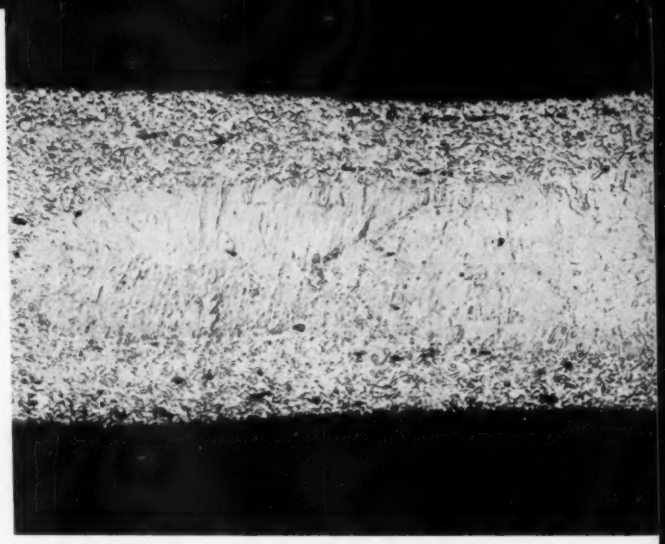


Fig. 5. Longitudinal section of seam weld in 0.003-inch 304 stainless at 250×.

The microscopic examination of seam welds revealed uniformly overlapping, sound welds. Fig. 5 shows one of these cross sections. The weld nugget is about 50 per cent of the thickness of the joint. This typical joint was made using the control settings listed below:

Weld trim	1 cycle (1/60 second)
Travel speed	6 ipm
Off time	15 cycles
Weld current	600 amperes (rms)
Weld force	80 pounds

These conditions were found to be suitable for the fabrication of the 0.003-inch foil containers. The welding parameters for various materials and thicknesses are easily determined. They will, of course, depend on the job requirements.

Machining with Abrasives Is Subject of Study

"Abrasive Machining" is the subject of an intensive research project now in progress at the Norton Co., Worcester, Mass. Results of this study are expected to show that machining of both castings and cutoff steel stock to final dimensions can be economically accomplished entirely with abrasive products.

For years it has been common machine-shop practice to use metal type cutting tools for heavy stock removal, and to use grinding wheels, if necessary, to arrive at specified dimensions and surface finish. Modern developments in grinding wheels and in the machinery on which they are employed indicate the timeliness of a thorough examination into abrasive machining as a method of reducing manufacturing costs.

This study will approach abrasive machining from the standpoint of the equipment required and of the economics involved. First phase of the project is the correlation of available information from all sources. Data thus gained will determine the areas of application which appear most promising for the second phase of the project—mechanical research into the equipment and techniques of applying abrasive machining.

Initial findings indicate that the greatest potential savings in the use of abrasive machining may be in the fields of flat-surface machining and in slotting and grooving applications because of the suitability of presently available equipment. With further developments, these savings will no doubt be extended to cylindrical machining.

How residual stresses from heat-treatment affect your product

Stresses produced in a part as a result of the various heat-treating processes can react favorably or unfavorably when combined with loading stresses. This article for the designer discusses many facets of the problem

M. F. SPOTTS
Northwestern University

MACHINE PARTS are heat-treated to obtain the desirable properties of strength, hardness, and grain structure for their design function. The high temperatures required are accompanied by plastic deformations and metallurgical changes which give rise to residual stresses after the workpiece has again cooled to the ambient temperature. Equations of mechanics give the stresses resulting from the loading applied to an initially stress-free body. These stresses, however, are algebraically additive to those due to heat-treatment. Since the effect of the latter stresses may be either favorable or unfavorable to the mechanical operation of the part, the situation should be given careful study by the designer.

The purely thermal effects on a ferrous cylinder of through-heating to and then quenching from a temperature somewhat below the lower critical value of 1330 degrees F. should first be considered. On immersing the part in the water, the surface cools at a very rapid rate. Contraction of the outer layers is largely prevented by the rigid core which remains for a time at the higher temperature. Tensile stresses are thus set up on the surface of the part and are balanced by compressive stresses in the interior. With the decrease in internal temperature and the accompanying thermal contraction of the core, the tension on the surface may be reduced to zero or turned into compression. When this happens, there will be a balancing tensile stress in the interior. The resulting stress distribution (shown diagrammatically in Fig. 1) is representative of that across the diameter of a long cylindrical body.

If, instead, the part is through-heated to a temperature above the critical value into the aus-

tenitic range, and the material contains a sufficient amount of carbon or alloying elements so that martensite forms on sudden cooling, the tension on the surface from thermal contraction occurs as before. However, the phase change to martensite throughout the part involves an increase in volume which, in turn, tends to increase the tension on the surface and the compression in the interior. Continued thermal shrinkage, as in the previous case, reduces the tension on the surface and may or may not change it into compression.

These thermal and transformation effects occur simultaneously. The exact manner of interaction, however, is highly complex, and has never been explained to the extent that the designer can predict just what the resulting residual-stress pattern would be. The final quenching stresses on the surface may, therefore, be either tension or compression, depending on the quenching temperature, the cooling rate, the size and shape of part, the carbon and alloy content, and the temperature at which the transformation to martensite occurs. The stress distribution over a cross section may be more complex than that shown in Fig. 1. A large tensile stress at the surface may cause warping and distortion or even cracking of the part. The tendency to crack is augmented by the presence of stress-raising features such as notches, grooves, holes, and re-entrant corners. A small projection from a larger body is vulnerable to the formation of quenching cracks in the region where the two sections are joined.

A symmetrical part may be straight and true after heat-treatment, providing the residual stresses are symmetrically distributed. Subsequent machining and grinding operations which remove the surface layers on but one side of the part can cause severe warping or other dimensional instability.

A surface with residual tension is vulnerable to the formation of fatigue cracks. Such conditions have undoubtedly been the cause of many failures. It is usually desirable to eliminate a surface tensile stress by subsequent heating to a suitable temperature. The temperature, however, must not be so high as to impair the structure produced by the previous heat-treatment. Residual tension can also be removed and the surface left in compression by mechanical operations such as rolling between rollers at high pressure, shot peening, tumbling, or peen hammering. A compressive stress so induced is balanced by a residual tensile stress in the interior.

On the other hand, a residential compressive stress on the surface is beneficial for parts with repeated or fatigue loading, and such a stress can cause a worthwhile increase in the factor of safety. It is known, however, that surface residual stresses tend to gradually lessen or fade with repeated loading. Tempering to restore a portion of the ductility causes a loss of surface compression. In fact, a tempering temperature of 1000 degrees F. may reduce the compression to zero or convert it into tension.

Oil quenching is less severe than water quenching. The heat is removed less drastically and the difference in temperature between the surface and the interior is less than for water quenching. The tendency for distortion and cracking is, therefore, less with oil quenching.

Localized surface heating with a flame or induction coil to below the critical transformation temperature, followed by rapid cooling, usually leaves the surface in tension. The cool interior of the body does not expand, and the attached heated layer must expand plastically outward. This enlarged material is unable to return to its

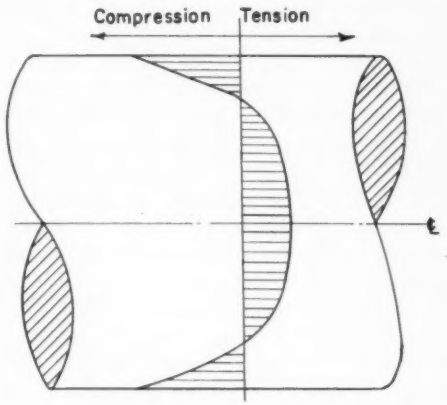


Fig. 1. Diagram showing the typical distribution of residual heat-treating stresses across the diameter of a long cylindrical part.

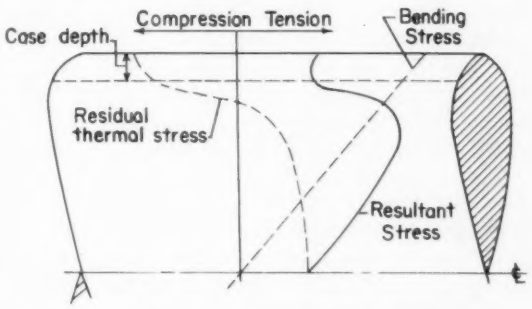


Fig. 2. Graphical representation illustrating how bending and residual thermal stress produce a maximum combined tensile stress below the surface of a case-hardened cylinder.

original size when cooled, and thus a residual tensile stress results.

Grinding cracks can be accounted for by the same process. Brake-drums, clutch plates, railroad wheels and rails, and other friction surfaces are affected in the same way. Flame-cut parts are usually left with tension at the surface. Contraction of weld metal deposited on relatively cold base metal produces a residual tension. Bent shafts can be straightened by heating on the outside of the bend. If the heat is properly applied, the resultant residual tensile stress in the heated region will produce a straight shaft.

Flame or induction hardening leaves the surface in a state of residual compression only when the steel is heated to a high enough temperature and has sufficient carbon or alloy content to undergo the phase change to martensite, upon quenching, from the austenitic condition. The increase in volume due to the martensite formation must be sufficient to overcome the thermal contraction of the heated layer.

At the edges of the heated region, the martensite gradually merges into the weaker surrounding material. When the part must be heated in sections, the junctions between the heated regions should be located at points where the loading stresses are low. For example, in hardening the teeth of a gear, the junctions should be at the tips of the teeth and not at the base, where the maximum bending stress occurs.

The surfaces of case carburized and nitrided parts can exhibit residual compressive stresses in the order of 80,000 to 100,000 psi. Carbon which has been absorbed by the surface layers during the heating period produces, on quenching, high-carbon martensite, which occupies more volume than low-carbon martensite. As a result, the surface compression is greater on cooling. Such treatments are especially beneficial for fatigue loading in the presence of stress concentrations. Surface induction hardening of medium-carbon steel also puts the surface in compression, but probably not to the same extent that occurs in carburized steel.

The combination of internal residual tension resulting from heat-treatment and tension resulting from a bending load can cause the maximum tensile stress to occur at a point beneath the surface, as illustrated in Fig. 2. It is possible for a fatigue failure to start at such a point should the endurance limit be exceeded.

On the other hand, there has been a case where a residual surface tension in a weld was beneficial, since it produced an adjacent layer that was highly stressed in compression. Fatigue cracks were readily formed in the tension-stressed material but were unable to penetrate the barrier of the highly compression-stressed metal. The joint, when not stress-relieved, withstood nine times as many load cycles as parts that were stress-relieved.

The factors to be considered in residual-stress problems are so numerous and involved that it is difficult to make definite predictions except along the general lines discussed here. An added problem is the fact that experimental determination of such stresses is difficult, time-consuming, and expensive. The literature on the subject, however, is very extensive.

Aluminum "Tube-In-Strip" Simplifies Fabrication of Space Simulation Chambers

Fabrication of General Electric's new space simulation chambers—which will permit decisions about spacecraft designs and thermal balance problems without actual flights—has been simplified by the use of aluminum "Tube-In-Strip." This material, made by Revere Copper & Brass, Inc., consists of one-piece solid sheets or strips in which inflatable tubing is integral with the metal.

It is being used in two distinct ways in the simulation chambers. In one application an internal shell of Tube-In-Strip is anodized black and has liquid nitrogen pumped through the tubes. It will appear to the test object, or satellite, like the dark regions of outer space. The test object will be surrounded by this shell or heat sink.

A second application makes use of the material in the form of small panels, called cryopanels, which will be attached to the interior of the shell. They will be cooled to minus 425 degrees F. with helium gas supplied from an external refrigerator. At this extremely low temperature the vapor pressure of air is less than one trillionth of an atmosphere. As a result, the air in the chamber will freeze out on the panels, creating the extremely high vacuum conditions of outer space.

Use of Tube-In-Strip eliminates the problem of bonding long lengths of tubing to metal sheet by soldering or welding. The tube, which is a part of the original sheet, provides excellent heat-transfer characteristics in this type of application. Also, because it is essentially seamless, it is free of small leaks. This is vital in high vacuum work.

The heat sinks and cryopanels, as well as the helium refrigeration equipment and liquid-nitrogen circulation systems, are being designed and built by CryoVac, Inc., Columbus, Ohio.

different-sized parts lapped in multiple quantities

Operations in which flat surfaces are finished automatically within 0.000005 inch, on as many as nine parts simultaneously

HARRY C. GUNETTI
Vice-President, Manufacturing
Kobe, Inc.
Los Angeles, Calif.

METAL-FINISHING techniques developed originally for the servicing of diesel-engine injectors and pumps, where tolerances of 0.000005 inch must often be maintained, are now being applied to the manufacture of oil-well pumping systems. This is being done at Kobe, Inc., Los Angeles, Calif., a major producer of hydraulic oil-well pumping systems. A four-year record of lapping critical parts with equipment developed for the diesel-engine industry has revealed a number of distinct advantages. It has also demonstrated that tolerances formerly possible to maintain only in laboratories can be obtained on a production-line basis in heavy industry.

The Kobe hydraulic system for pumping oil wells replaces the long familiar walking beam and prime mover at the head of each well which are connected by a string of sucker rods to a pump at the bottom of the well. Instead, a motor- or engine-driven, high-pressure triplex pump supplies power to one or more production units at the bottom of their respective wells. Pressures up to

Fig. 1. Lapping operation in which nine carbon seals are being simultaneously finished to a flatness within a few millionths of an inch.

5000 psi are required in this system, and four sizes of bottom-hole pumping units are produced by the concern.

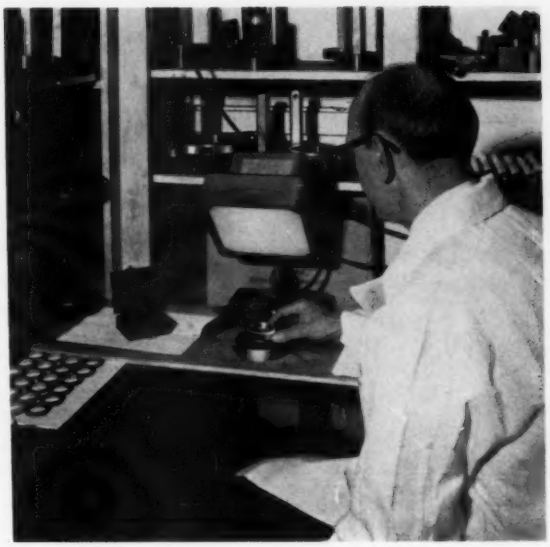
The complete hydraulic engine and pump assembly, located at the bottom of the well, ranges in size from 1 7/8 inches in diameter by 78 1/2 inches long to 3 13/16 inches in diameter by 173 inches long. In the smallest units the engine piston is 1 inch in diameter and the direct connected pump piston is 13/16 inch in diameter. The operating speed is ninety-one strokes per minute at a maximum setting depth of 15,000 feet. The largest of the bottom-hole units has an engine-piston diameter of 2 inches and a pump-piston diameter of 2 3/8 inches. It operates at a speed of fifty-seven strokes per minute at a setting depth of 6500 feet.

In each bottom-hole unit, there are twelve critical parts, from the standpoint of finish, that are now lapped to the tolerances ranging from one-half light band (0.0000058 inch) to two light bands. They are the valve body, dashpot plug, exhaust-valve cage, valve plate, intake-valve cage, and middle plug in the engine and the corresponding parts in the pump portion of the unit. The need to lap these parts to the degree of flatness named is apparent from the fact that each part must be mated to maintain the 5000-pound pressure differential across the sealing faces. A grouping of the most critical parts is presented in the heading illustration. The materials used include Nitralloy, solid tungsten carbide, stainless steel, Stellite, and carbon steel.

While the manufacture of pumps and bottom-hole pumping units is a substantial business, reconditioning of the bottom-hole pumps represents an additional major shop load. In this phase of the shop operations semiautomatic, production-line lapping has almost completely displaced hand lapping. Semiautomatic lapping was first tried in 1957, when a single-spindle Spiralap machine was installed for carbon seals and certain Stellite parts.

One of the former problems was that the manufacturer of the carbon seals could not consistently maintain a finish of one-half light band on a production basis. Many hours of hand lapping were required each year to bring the carbon seals

Fig. 2. Checking the flatness of lapped parts with an optical flat beneath a monochromatic light.



within the specified degree of flatness. The procedure for the past three years has been to lap all seals when they are received from the supplier on a single-spindle Spiralap machine with a 12-inch lapping plate. A 10-inch diameter Micarta fixture holds up to nine seals at one time, for simultaneous lapping. An automatic timer stops the lapping machine after a predetermined time up to sixty minutes. A close-up view of a typical machine is shown in Fig. 1.

Adjacent to the lapping machine is a monochromatic light source for use in checking each part with optical flats as it comes from the machine, as shown in Fig. 2. The use of optical flats also determines the necessity of relapping the plates. This is accomplished by the alternate use of the three spirally grooved plates supplied with each machine. When plate No. 1 has reached the point where it is in need of rework, plate No. 2 is placed on top of plate No. 1 and located off-center by means of adjustable idler bearings. The two plates are allowed to run mated with each other for a period of from fifteen to thirty minutes.

At the beginning of the next work period, plate No. 1 is set aside and plate No. 2 is placed on the machine spindle. At the end of a period of time determined by the operator's experience or when the optical flat shows the need for reworking this

Fig. 3. Two installations of double-spindle machines regularly employed for lapping as many as eight different parts at each station.

Fig. 4. Diagrams illustrate how ring seals appear underneath optical flats before and after lapping. Out-of-flat surface is indicated at left. Flat surface obtained after spiral lapping is indicated at right.

plate, plate No. 3 is allowed to ride on plate No. 2 for a mating period and then used for the third work period.

This process of interchange continues with plate No. 1 mating with plate No. 3 before being used for the fourth work period. By using three plates for alternately lapping parts and relapping their own surfaces, maintenance of flatness is virtually automatic over an indefinite period of time. Only if a plate is damaged through careless handling is it necessary to resurface a plate. In Fig. 3, the operator is seen washing the lapping surface of a typical plate.

Typical optical-flat readings of a part before and after Spiralapping are indicated in Fig. 4. A reading somewhere between the two extremes, after a predetermined number of minutes of lapping, would indicate the need for relapping of the plate. The group of Nitralloy steel seal rings at the left in Fig. 2 have been removed from the lapping machine. The technician is optically checking such rings for flatness to within one light band (0.0000116 inch).

The two double-spindle machines in Fig. 3 are used for lapping a wide variety of shapes, weights, and sizes of parts on a mass-production basis in a division of the plant that is a part of the reconditioning department. While the operator is cleaning a plate work is in process at the other three stations of the two machines. Between the two lapping stations on each machine is a washing tray for cleaning the work parts and the plates after they have been relapped. The washing oil is fed through a Winslow filter mounted to the left of the holding fixture at the back of the washing tray.

Experience has shown that parts of dissimilar size and weight can be simultaneously lapped, with uniform results, by loading weights on the lighter parts to bring their weight up to that of the heaviest part. On the shelf above the lapping machines in Fig. 3 are an assortment of such loading weights and Micarta fixtures for various groups of parts. Eight parts are being lapped in Fig. 5, six of them loaded to bring their weight up to that of two heavy parts. A variation in weight of no more than 10 per cent has been found permissible. In this lapping operation, the means of holding the fixture off-center by the use of the adjustable idler bearings, is shown. Provision is made for adjusting the bearing arms in or out with respect to the center of the lapping plate for accommodating smaller or larger plates.

To maintain a uniform lapping pressure on each piece that must be weighted, a ball is placed in the center of the piece as indicated in the middle diagram of Fig. 6. In this way, pressure created by the weight is transmitted to the center of the part. The other two diagrams in this illustration show parts that do not require weights. The lower plug and the valve body are within 10 per cent of the same weight, and the valve plate is loaded to equal the weight of the lower plug. When such parts were hand-lapped one at a time there was no assurance that all pieces of a lot would be lapped to the same degree of flatness.

The fixtures have recently been modified to consist of a combination of Micarta and aluminum. The newer fixtures have approximately 1/4 inch of Micarta in contact with the lapping plate. The balance of the fixture is an aluminum plate with the Micarta bonded to it.

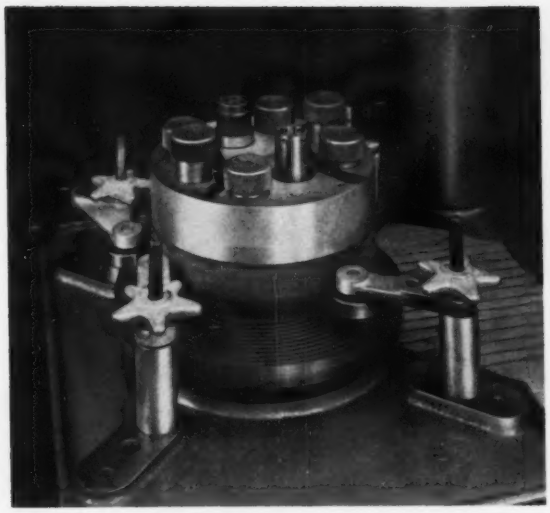


Fig. 5. Close-up view of one of the lapping fixtures set up for eight different parts, six of which are weighted to obtain a uniform load on all parts.

Different combinations of lapping plates and compounds are used to suit the work material. Standard Spiralap plates are chromium-nickel cast-iron alloy. Each plate is charged with either a diamond lapping compound, Norbide, or aluminum oxide, depending upon the material to be lapped and degree of finish and flatness desired.

For example, the plates used to lap the carbon seal rings are charged with 3-micron diamond dust. Compounds are of the paste type, which have proved superior to oil types. Silicon-carbide compounds with a grit size ranging from 100 to 400 are generally used as all-purpose toolroom lapping compounds. Other compounds range from corundum of a 400-grit size to medium-hard alumina with a grit size of 1 to 3 microns. These compounds are used for stainless and chromium steels. The spiral groove in the lapping plates, from which the trade name of the machines was derived, tends to continuously spread the compound across the entire working surface of the plate. It also permits use of the major portion of the plate surface, for either lapping a large piece that could cover as much as 90 per cent of the plate surface or a multiplicity of smaller parts held in a fixture.

The use of rotary spirally grooved lapping plates has resulted in a number of distinct advantages, the most important of which is uniform flatness of critical parts. This has been obtained with a marked reduction in cost because the control of quality is in a machine rather than dependent on human skill. One operator can lap as many as thirty-two pieces simultaneously on four plates, in contrast to the former hand lapping of one piece at a time. The Spiralap machines were developed by Marine Pumps, Inc., Division of the Diesel Control Corporation, Wilmington, Calif.

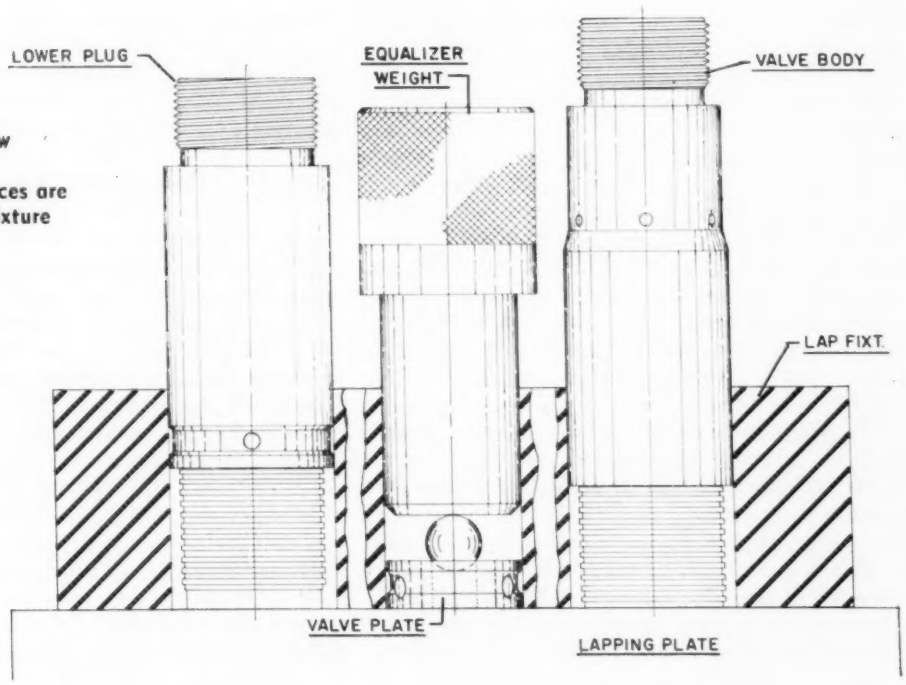


Fig. 6. Diagrams show how weighted and unweighted work-pieces are set up in the work-fixture for precise lapping.

RONALD W. MORAN
Manager of Engineering
Fafnir Bearing Co.
New Britain, Conn.

The never-ending search for improved performance of grinding wheel-heads for the machine tool industry has led to an extensive testing program on the key components—high-speed ball bearings

Improved retainers upgrade high-speed ball-bearing performance

SUPERFINE FINISHES and dimensional stability of processed work are possible with grinding wheel-heads operating at high speeds and at low temperatures. The Fafnir Bearing Co. has developed an ultraprecision design of ball bearing for use at speeds up to 150,000 rpm. It is an angular type bearing having an outer ring of Conrad design, with symmetrical outer-ring shoulders for a one-piece land-riding retainer, and a counterbored inner ring. This copes efficiently with the change in contact angle of the bearing caused by the centrifugal force of the balls at high spindle speeds.

Preliminary testing of high-speed wheel-heads incorporating grease-lubricated ball bearings of this type showed that abnormally high break-in temperatures deplete the grease of its lubricating qualities to a degree that is harmful. In fact, it is serious enough to cause early bearing failure, with the resultant need for bearing replacement. Consequently, speed should be kept low during the break-in period.

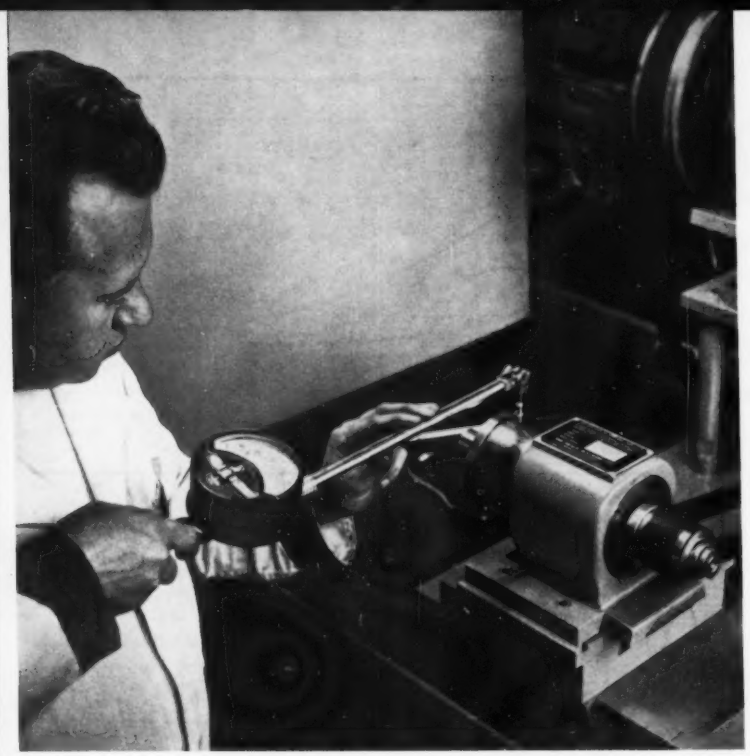
This preliminary test was part of an extensive program covering a period of a year, for a total of 12,000 operating hours. It included tests on four sizes of grease-lubricated grinding wheel-heads operating at speeds ranging from 10,000 to 30,000 rpm. Each wheel-head employed two pairs of ball bearings mounted in tandem to form a back-to-back spring-loaded arrangement.

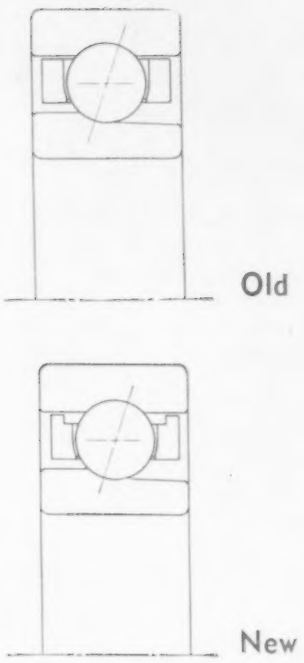
Initial tests showed that wheel-heads employing 35-millimeter bore bearings, and operating at 14,000 rpm, developed the highest break-in temperatures. Thus, particular attention was given this size wheel-head. The temperatures that developed in the initial break-in runs varied from 80 to 150 degrees F. above normal ambient. Equilibruim temperature was reached in three and one-half to eight hours. The equilibrium temperatures above ambient varied between 27 and 58 degrees F. These were considered too high for good wheel-head performance. The time-temperature readings are plotted on Chart 1.

Conventional Retainers

The first tests were run with bearings having conventional, phenolic-composition retainers (shown in section, Fig. 1) and lubricated with a soft-consistency grease. With the bearings operating at high speeds, the centrifugal action of the retainers and balls caused an outward radial movement of the grease. Thus the lubricant accumulated in the outer-ring raceway and also in the small running clearance between the outside of the retainer and the outer-race bore. Practically all of the remaining grease in the bearing was confined to this area, since the close-running clearance restricted its escape. Expelled lubricant built up in cavities near the outer rings.

Since the consistency of this grease is soft, a churning action occurs followed by an appre-





ciable temperature rise. Considerable time is required before the bearing can expel the churned lubricant and be relieved of the heat-generating condition.

Greases that were tested are tabulated below:

Grease	NLGI Consistency Number	Oil-Base Viscosity
A	2 to 3	150 SUS at 100 degrees F.
B	0 to 1/2	100 SUS at 100 degress F.
C	1/2 to 1 1/2	256 SUS at 100 degrees F.
D	1 1/2 to 2	56 SUS at 100 degrees F.

Greases A, B, and C gave the best performance.

Similarly, a channeling type grease was used in some of the early tests. No high break-in temperature developed with this grease, but it was noted that the operating temperature increased slightly from day to day. A temperature of 35 degrees F. above ambient was reached during the first day. This increased to 42 degrees F. during the third day, and 48 degrees F. during the seventh day. Seven runs were made for a total test time of eighty-five hours.

Since the consistency of this grease is heavy, none that is expelled ever gets back into the bearing. The grease remaining in the bearing is confined between the periphery of the retainer and the outer-ring bore. Due to the high shear rate resulting from the milling of the grease, it rapidly loses its lubricating qualities. As it loses its oil the grease becomes stiffer, with the result that the operating temperature continues to rise. The fact that no high break-in temperature develops is characteristic of this grease. Very little churning action occurs because it is of the channeling type and is essentially stiffer than greases of softer consistency. Lubrication of the rolling elements occurs when oil is picked up by a wiping action of the rotating parts.

Beveled Retainers

In order to accelerate the rate of discharge of grease, and to prevent its build-up between the retainer and outer ring, conventional retainers were beveled on each outside corner as shown in Fig. 2. Two sets of bearings using these retainers were tested in wheel-heads, lubricated with the soft-consistency grease, under operating conditions identical to those in the tests employing bearings having conventional type retainers.

The break-in temperature of these tests, which was reached in twenty minutes, peaked at 80 degrees F. above room heat. The time required to reach equilibrium temperature—28 degrees F. above room, Chart 2—was two and one-half to three hours. These results represent an appreciable improvement over those of the conventional retainer design shown on Chart 1.

Fig. 1. Conventional ball-bearing retainers were the first type tested, using grease B. Temperature-versus-time chart compares performance during two runs.

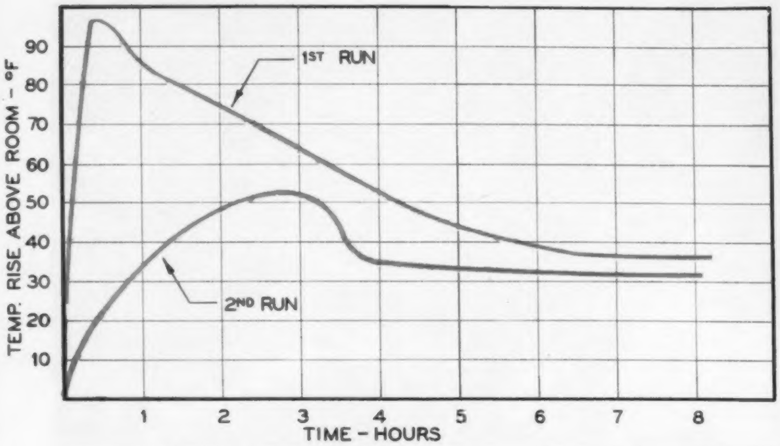


Fig. 2. Beveling of conventional retainers simplified discharge of grease and prevented its build-up between retainer and outer ring. Results showed improvement over conventional type.

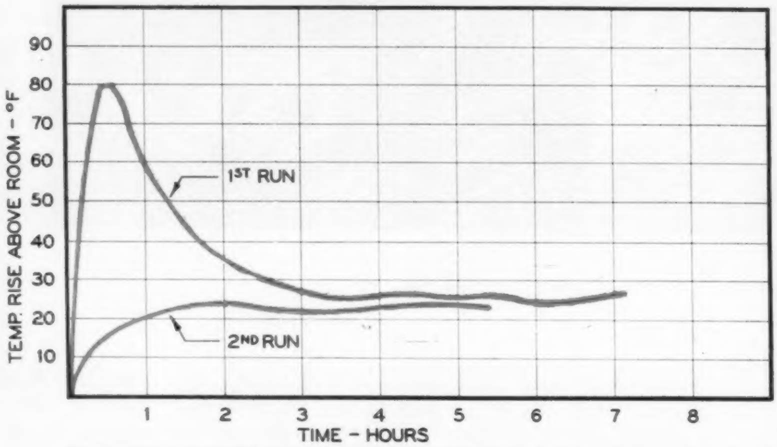


Fig. 3. Further improvement was realized (see chart) when a channel was formed around the periphery of the retainer. Channel width equalled ball-pocket width.

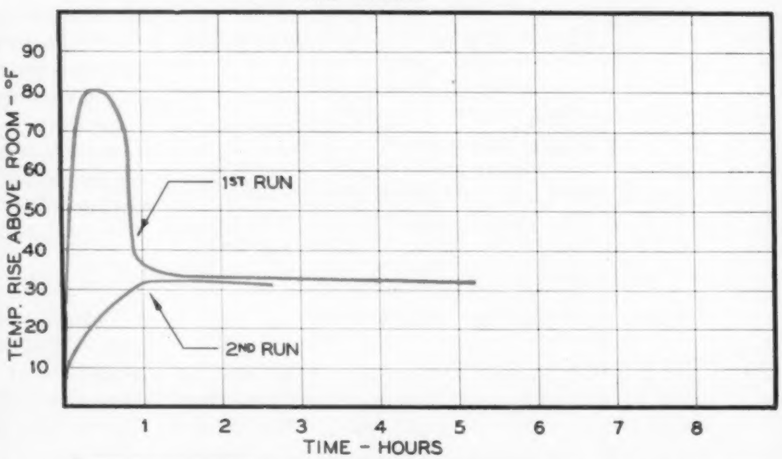
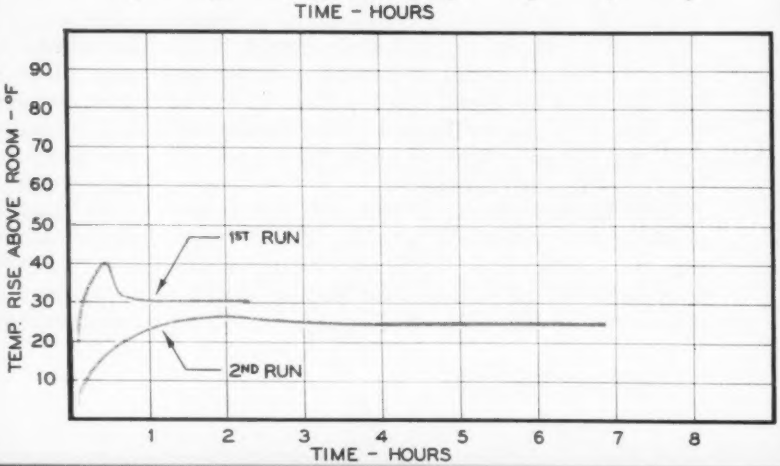


Fig. 4. Wheel-head bearings with wide-channeled retainers (0.052 inch wider than ball pocket) proved the most effective of all designs tried at high speeds.



Channeled Retainers

It became evident after the second series of tests that further improvement could be attained with bearings having channeled retainers as shown in Fig. 3. The channel was recessed 0.040 inch deep from the outside surface and equal in width to the ball pockets. Tests were made with bearings assembled with these retainers under the same operating conditions as for the conventional and beveled retainers.

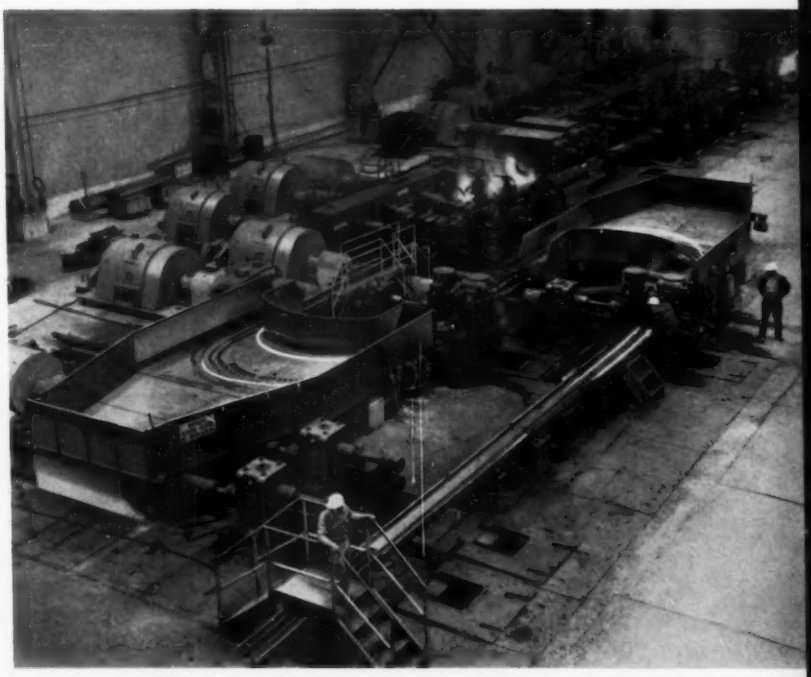
The maximum break-in temperature was 80 degrees F. above room temperature, the same as for the beveled-retainer bearings, but equilibrium time was only one hour. Equilibrium temperature was 32 degrees F. above room, Chart 3. Retainers recessed to 0.050 inch deep were also tested, but showed no significant improvement.

From the results obtained with these channeled retainers it became apparent that if the recess were extended beyond the ball-pocket diameter, further improvement might be expected. Conventional retainers were, therefore, channeled to a depth of 0.050 inch, and to a width 0.052 inch greater than the diameter of the ball pocket, Fig. 4.

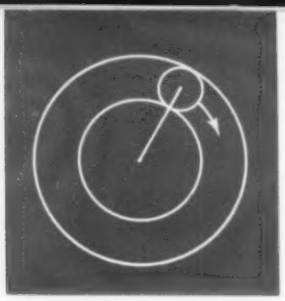
Bearings equipped with these retainers were tested in the same wheel-heads as before. The maximum heat reached during the initial run was only 40 degrees F. above room temperature. Equilibrium time was only thirty minutes and the equilibrium temperature was 30 degrees F. above room, Chart 4. For all practical purposes, retainers of the broad-channeled construction eliminated the objectionable high break-in temperatures encountered with conventional type retainers.

Now underway at the Fafnir Bearing Co. is a testing program using both conventional and channeled retainers for these high-speed ball bearings, but with air-oil-mist lubrication replacing grease. For the 205 wheel-head, operating at 25,000 rpm with air-oil-mist lubrication, the average rise in temperature above room reached 38 degrees F. for bearings having conventional retainers, but only 16 degrees F. for those having channeled retainers.

Test results for the wheel-head operating at 15,000 rpm, equipped with spring-loaded tandem pairs of 50-millimeter bore ball bearings and air-oil-mist lubricated, show that with the conventional retainers the average temperature rise above room was 75 degrees F., while for the channeled retainers the temperature rise was only 40 degrees F. With either grease or air-oil-mist lubrication, the wide-channeled retainers serve to lower the operating temperature of wheel-heads equipped with ball bearings.



A 5-ton bundle of No. 3 (3/8-inch diameter) reinforcing rods can be shipped every ten and one-half minutes from the new reinforcing-bar mill and bar-fabricating shop at Bethlehem Steel Co.'s Steelton, Pa., plant. Annual capacity of the new installation, which has begun full production runs, is 350,000 tons of deformed type concrete reinforcing bars in sizes from Nos. 3 to 11, inclusive. Billets travel through the mill from roughing stands (upper right in the illustration), through intermediate stands, two looping stands, and finally, the finishing stands. Large steel pans of looping stands, called repeaters, allow the bar to flex and flare out should there be any difference in relative speed at the leading or trailing end of the bar.



Don't overlook the basic Epicyclic gear

EPICYCLIC GEARS are normally used only where no simpler arrangement of gearing will suffice. The simplest form of epicyclic gear assembly (Fig. 1) may, however, be considered as a means of reducing speed in a ratio in the range from about 2 1/2 to 6. This article discusses in general terms how these gear assemblies can compete with single pairs of parallel-shaft gears for the same duty.

If the letter symbols in Fig. 1 are taken to represent the numbers of teeth in the corresponding gears, the ratio of the angular velocity of the input shaft to that of the output shaft is $m_G = (A + C)/A$.

An obvious means of increasing the load capacity of the assembly without increasing the external dimensions is to use more than one planet gear. The number of planets is limited to the maximum that can be employed without interference between adjacent pinions in the group and is dependent on the ratio of A to C. With symbol r representing the pitch radius of gears identified by subscript and, for simplicity, ignoring tooth parts projecting beyond the pitch circles, examination of Fig. 2 shows that for z planetary pinions just interfering at their pitch circles

$$\sin PST = \frac{\overline{PT}}{\overline{PS}}$$

or

$$\sin \frac{\pi}{z} = \frac{r_B}{r_A + r_B} = \frac{B}{A + B}$$

but

$$B = \frac{C - A}{2}$$

and, therefore,

$$\frac{B}{A + B} = \frac{C - A}{A + C} = 1 - \frac{2A}{A + C} = 1 - \frac{2}{m_G}$$

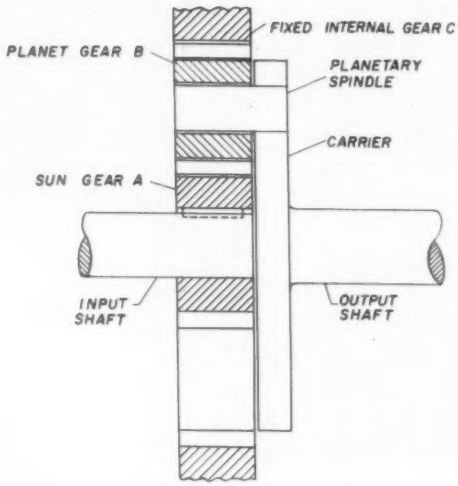


Fig. 1. This, the simplest form of epicyclic gear assembly, can compete with a parallel-shaft gear pair for certain applications involving velocity ratios between 2 1/2 and 6. Three planet gears provide the best arrangement.

W. A. TUPLIN
Professor of Applied Mechanics
University of Sheffield, England

The simplest form of epicyclic gear assembly has advantages over a pair of parallel-shaft gears for certain applications requiring velocity ratios between 2 1/2 and 6. Here, a comparison study of the two alternative gearing arrangements is made and some unique features of the epicyclic assembly are presented

Hence, for the limiting condition,

$$\frac{2}{m_G} = 1 - \sin\frac{\pi}{z}$$

or

$$m_G = \frac{2}{1 - \sin\frac{\pi}{z}}$$

Maximum velocity ratios m_G corresponding to z planetary pinions (above 2) are given in Table 1.

Each value of m_G is the maximum possible for the value of z for teeth of negligible depth. With teeth of useful depth the maximum possible velocity ratio m_G is less than that shown in the table, and gears may be designed for any lower value of this ratio.

Increasing the number of planet gears does not, in practice, effect an equal increase in the load capacity of the assembly because the implied uniform distribution of the load between more than three planets would demand impracticably fine tolerances on many dimensions, including the spacing of the planetary spindles. When encircled by three planets, the sun gear needs no support beyond what they provide and is moved by the tooth reactions into a position that equalizes these forces. This condition does not occur with a greater number of planet gears, so it is doubtful whether there is any substantial advantage in using more.

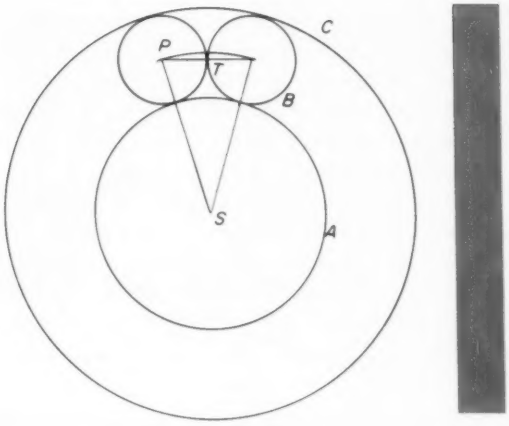


Fig. 2. Diagram showing the geometric relationship between the various gear pitch circles for use of a maximum number of planets.

The torque capacity of a pair of gears may be compared with that of an epicyclic gear assembly of this type on the basis of a common primary-pinion diameter d_A and a common face width for all gears. The diameter of the mating gear in the

Table 1. Maximum Velocity Ratios m_G and Values of C/A and B/A for Epicyclic Gear Assemblies of the Type Seen in Fig. 1 Having Three to Eight Planetary Pinions

Number of planets z	3	4	5	6	7	8
Velocity ratio m_G	14.9	6.8	4.85	4	3.54	3.34
Ratio C/A	13.9	5.8	3.85	3	2.54	2.34
Ratio B/A	6.45	2.4	1.43	1	0.77	0.67

Table 2. Ratio of Various Design Values for the Epicyclic Gear Assembly, Fig. 1, to Those for a Simple Pair of Gears Compiled for Typical Velocity Ratios m_G

Velocity ratio m_G	2.5	3	4	5	6
Ratio of allowable input torques	0.84	1.34	1.87	2.16	2.34
Ratio of over-all dimensions perpendicular to axes	0.43	0.5	0.6	0.67	0.71
Ratio of total numbers of teeth	0.93	1.12	1 4	1.58	1.71
$\frac{\text{Ratio of allowable torque}}{\text{Ratio of total numbers of teeth}}$	0.9	1.2	1.34	1.37	1.37

Table 3. Ratios of Allowable Input Torques and Over-All Dimensions for the Epicyclic Assembly (Fig. 1) to Those for a Simple Gear Pair Where Both Arrangements Have the Same Total Number of Teeth

Velocity ratio m_G	2.5	3	4	5	6
Ratio of allowable input torques	0.97	1.06	0.96	0.86	0.8
Ratio of over-all dimensions perpendicular to axes	0.46	0.45	0.43	0.42	0.42

first case is $m_G\, d_A$, while in the epicyclic assembly

$$d_C = (m_G - 1)d_A \qquad \text{and} \qquad d_B = \frac{1}{2}(m_G - 2)d_A$$

Tooth loading is limited by safe surface stresses to a value proportional to the relative radius of curvature of the tooth profiles at the pitch point or, for a given standard tooth system, to the reciprocal of the sum of the reciprocals of the diameters of the pitch circles.

Hence the ratio of allowable tooth loading (and therefore of allowable input torque) of the epicyclic gear with three planets to that of the simple gear pair is:

$$\frac{3\left(\frac{1}{d_A} + \frac{1}{m_G\, d_A}\right)}{\frac{1}{d_A} + \frac{2}{(m_G - 2)\, d_A}}$$

$$= \frac{3\,(m_G + 1)}{m_G\left(1 + \frac{2}{m_G - 2}\right)}$$

$$= \frac{3\,(m_G + 1)\,(m_G - 2)}{m_G{}^2}$$

Values of this ratio for typical velocity ratios M_G are given in Table 2. In this table the second line of entries gives the ratio of the diameter of the pitch circle of the internal gear in the epicyclic assembly to the sum of the diameters of gear and pinion in the simple pair. In an approximate way this is a measure of the ratio between the amounts of space occupied by the two alternate gearing arrangements.

The third line of entries in Table 2 gives the ratio of the total number of teeth in all the epicyclic gears to the total number in the simple pair. This may be taken as a rough comparison between the manufacturing costs of the gears in the two schemes.

The first two lines of entries show that the epicyclic gear assembly is appreciably smaller in over-all dimensions and that for most values of velocity ratio m_G it has considerably higher load capacity. The last line suggests that on the basis of torque capacity per unit cost, the epicyclic gears may have an appreciable advantage. On the other hand, the complete epicyclic gear assembly includes more spindles and bearings than does the simple pair of gears. In addition, the internal gear is more expensive to produce than an external gear of the same major dimensions. This comparison, therefore, fails to demonstrate any appreciable difference between the two schemes in probable cost.

An alternative is to compare assemblies with a common total number of teeth, which means ap-

proximate equality of manufacturing costs for the gears themselves. The total number of teeth is proportional to the total circumference of all the pitch circles; and so, for equality in this respect,

$$d_{A1}(1 + m_G) = d_{A2}\left(1 + \frac{3B}{A} + \frac{C}{A}\right)$$

$$= d_{A2}\left[1 + \frac{3(C - A)}{2A} + m_G - 1\right]$$

$$= d_{A2}\frac{(5m_G - 6)}{2}$$

The ratio of allowable tooth loads in this case is:

$$\frac{3\left(\frac{1}{d_{A1}} + \frac{1}{m_G d_{A1}}\right)}{\frac{1}{d_{A2}} + \frac{2}{(m_G - 2)d_{A2}}}$$

$$= 3\left[\frac{(m_G + 1)(m_G - 2)}{m_G^2}\right]\frac{2(m_G + 1)}{(5m_G - 6)}$$

Multiplication of this by $\frac{d_{A2}}{d_{A1}}$ shows the ratio of allowable input torque in the epicyclic assembly to that in the simple gear pair to be

$$12\left[\frac{m_G + 1}{m_G(5m_G - 6)}\right]^2 (m_G + 1)(m_G - 2)$$

Some values of this ratio and of the ratio of over-all size perpendicular to the shaft axes are given in Table 3.

The epicyclic assembly is shown in this table to be inferior in load capacity for approximately the same cost of gears—and therefore decidedly so, on the basis of total cost of the whole assembly—for any velocity ratio in the range considered in this article.

The epicyclic assembly has the advantage of smaller over-all dimensions, and the coaxiality of its input and output shafts may make it more easily accommodated in a restricted layout. On the other hand, the epicyclic assembly has a distinct disadvantage in that it is likely to emit more noise from the six meshing zones than does the simple gear pair from its single meshing zone. Moreover, it is difficult or impossible to support all the gears in the epicyclic assembly as rigidly as is normally practical in the alternate simple parallel-shaft pair.

Permissible Number of Planetary Pinions

These comparisons are based on the use of three planetary pinions. A larger number would give the epicyclic gear a greater advantage if load capacity were proportional to the number of planets. But, besides the considerable doubt of this occurring, there is the certainty that the possible number of planets is subject to an upper limit defined by the need for clearance between them. In addition, a restriction is imposed by the need for a tooth spacing in relation to the planetary spindles that will enable all planets to be inserted between the sun pinion and the internal gear. This limitation is illustrated in Fig. 3.

In this case the planetary pinion has its center at *A*, and the center line of each of two teeth coincides with *OA*. Point *B* is the intended position of the center of the adjacent pinion, angle *AOB* therefore being 360 degrees/z. However, line *OB* does not coincide with the center of any tooth space in the sun gear or in the internal gear, but crosses the pitch circle of the internal gear at a point *Q*, a distance from the center of a tooth space in the internal gear equal to an integral number of pitches plus a fraction k. If a planet centered at *B* is given an angular setting such that a tooth enters the tooth space of the internal gear immediately to the left of *OB*, then the opposite tooth of the planet will lie in a tooth space of the sun gear only if the center of that space is displaced by k times the pitch of the teeth to the right of *OB*. These conditions are expressed by the equations:

(Number of teeth in internal gear)/z = whole number + k

(Number of teeth in sun gear)/z = whole number − k

By adding these equations it is seen that the condition for assembly to be possible is that the sum of the numbers of teeth in the sun gear and the internal gear shall be exactly divisible by the

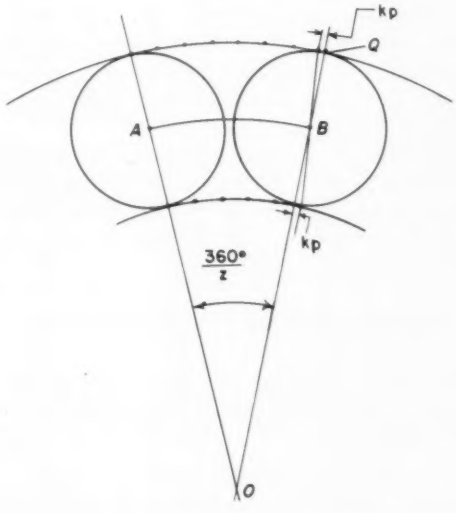


Fig. 3. Gear-tooth relationships that are necessary for assembly of a planet gear in the simple basic epicyclic gear arrangement seen in Fig. 1.

number of planets. The number of teeth in each planet does not enter this calculation. In Fig. 3 the number of teeth in the planets is even, but it might equally well be odd so far as assembly is concerned. For the conditions discussed, the numbers of teeth in the planets must be either all even or all odd, but they need not be identical.

If the number of teeth in the planet at A in Fig. 3 is even, as shown, but the number of teeth in the planet at B is odd, then the conditions for assembly to be possible are:

(Number of teeth in internal gear)/z = whole number $+ k \pm 1/2$

(Number of teeth in sun gear)/z = whole number $- k \pm 1/2$

By adding these, the assembly condition is found to be:

(Sum of teeth in internal gear and sun gear)/z = a whole number $+ 1$, or $+ 0$, or $- 1$, and this is the same as before.

It must be noted that since, in this scheme, the numbers of teeth in successive planets must alternate between even and odd, such an arrangement cannot be used unless the number of planetary spindles is even.

Nonuniform Spacing of Planetary Spindles

The foregoing assumes that the planetary spindles are to be uniformly spaced. If this restriction is removed, then the numbers of teeth in the gears cause no restriction on the number of planetary spindles that may be used and the planets need not have any common number of teeth.

Uniform spacing of the planetary spindles is natural and is advantageous in causing the centrifugal forces exerted by the planetary spindles on their rotating carriers to balance each other. Nonuniform spacing would necessitate special balancing of the planetary gear assembly if it were required to run fast.

A possible advantage of nonuniform spacing is that (in general) it produces differences between phases of engagement in the different meshing zones at any instant, and this may tend to result in a quieter running assembly.

Relation Between Numbers of Teeth

The simple geometry of Fig. 1 suggests that an essential relation between the numbers of teeth in the gears is

$$C = A + 2B$$

This is, in fact, the case if the (operating) pitch circle of gear B with gear A coincides with the (operating) pitch circle of gear B with gear C. Conventional design procedure is based on this identity, but it is not essential and departures from it are sometimes useful. The one basic essential is that the designed center distance of any pair of gears is the sum of their tip radii less the working depth of the teeth.

The number of spur or helical teeth that may be satisfactorily cut by a generating process using a cutter of normal pitch p_n in a blank of diameter d_o may have any value between

$$\left[\frac{\pi d_o}{p_n} - 4 + \frac{10\cos^2\psi}{\frac{\pi d_o}{p_n} - 4}\right]\cos\psi$$

and

$$\left[\frac{\pi d_o}{p_n} - 1 - \frac{20\cos^2\psi}{\frac{\pi d_o}{p_n} - 1}\right]\cos\psi$$

where ψ is defined by:

$$\sin\psi = (\text{normal pitch})/(\text{axial pitch}) = p_n/p_a$$

Conversely, the blank diameter of a spur or helical gear with N teeth generated by a cutter of normal pitch p_n and conjugate to a basic rack with a 20-degree flank angle and a working depth equal to $0.636\ p_n$ is given by

$$d_o = \left(\frac{p_n}{\pi}\right)(N\sec\psi + V)$$

where V may have any value that

(a) exceeds $1 + \dfrac{20\cos^3\psi}{N}$

but (b) does not exceed $4 - \dfrac{10\cos^3\psi}{N}$

For an internal gear

$$D_o = \left(\frac{p_n}{\pi}\right)(N\sec\psi - V)$$

where V may have any value that

(a) exceeds 2

but (b) does not exceed $3 - \dfrac{20\cos^3\psi}{N}$

If full use be made of this latitude in determining blank diameters (or numbers of teeth), it is never necessary to use a cutter of a nonstandard normal pitch for generating the teeth of gears of any epicyclic gear assembly that is arranged in the simple basic design.

DELMAR W. KARGER
Head, Department of Management Engineering
Rensselaer Polytechnic Institute
Troy, N. Y.

THINKING WITH MANAGEMENT

MERGERS AND ACQUISITIONS

A very practical and popular avenue to achieving corporate growth is through mergers, acquisitions, or both. It is a route paralleling that involving the firm's internal development of new products. Both activities can be carried on at the same time.

Many lists have been compiled giving reasons for merging or acquiring companies. However, few look seriously at "the other side of the coin"—why owners become sellers. Here are some of the more important reasons:

Dissension in the Ranks. A hard-hitting team of partners may work well together during the demanding period of a firm's formation and initial growth, only to split when they reach the point where they must sit back and establish long-range plans and policy. When such squabbles cannot be resolved, there is only one solution—sell out.

Personal Diversification. An owner-manager often finds that his years of effort have concentrated much or all of his wealth in his business. He, like many of today's corporations, may feel a great need and compulsion to diversify his holdings in order to provide for greater future security. Selling his business is the only possible way to achieve his goal.

The Narrow Product Line. Small enterprises with narrow product lines often encounter, especially as they mature, relentless and growing competition from larger firms having broader product lines. These larger firms also have the resources to expand and intensify the competition. For some such small firms, especially those with limited resources, selling or merging is the best course.

Death in the Business Family. This has become one of the familiar reasons for the sale of closely held businesses. Federal estate taxes range from 3 to 77 per cent, and must be paid in cash. Also, it is almost impossible to predict the valuation to be placed on a going business for estate purposes. These factors, combined with the inability to forecast the exact time of the owner's death, often cause the owner to sell out as part of an estate-planning move. If death occurs prior to the sale, a sudden need for cash may force the sale of the business.

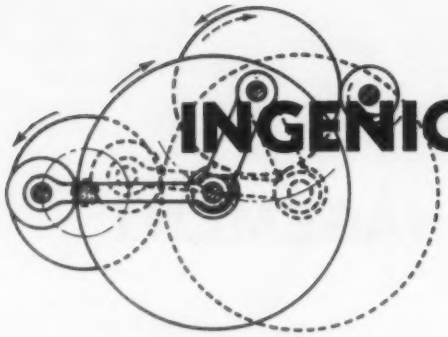
The Price of Automation. Many small firms cannot afford the cost of automation; nor can they afford to continue using large amounts of expensive hand labor. Selling or merging may be the most practical solution to their problem.

Business Complexity. All business is becoming increasingly complex. When a firm is too small to maintain its own staff of specialists to deal with new conditions, the small-company owner may seek a release through sale or merger.

Vertical Integration. Uncertain supplies of raw materials and components, on one hand, and varying requirements of independent distributors or prime contractors, on the other, often create an urgent need for vertical integration. The small enterprise may integrate either up or down on the ladder of its industry to eliminate one or more of its troublesome business variables.

Working-Capital Squeeze. The growth of any business has its own special financial problems. As sales increase, so do inventory accounts receivable and cash requirements—two principal elements comprising the item known to the accountant as working capital. The cash needed to run an expanded business must come from profits or from borrowing. In the early years of a business, profits are likely to be small, and bankers always put too much of their faith in the small firm's record of earnings. But when the working-capital squeeze is exerted, many firms decide to sell out.

Does one of the above categories fit your firm? If so, seriously consider either merging or selling. If, on the other hand, you are a major or larger company, you may want to use one or more of these causes as arguments to eliminate a thorny small competitor or to otherwise expand the base of your enterprise.



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Instant-Acting Centrifugal Governor

J. Boas Popper, Kirjat Mozkin, Israel

A steam turbine in a chemical plant was required to operate below a certain rotational speed. For the particular application, the use of a conventional centrifugal governor would not be satisfactory, since it would reduce steam gradually by starting the decrease before the turbine reached the maximum allowable speed. This would cause a hunting effect when the speed is adjusted by means of the manual valve and would require the use of an especially complicated automatic setup. The desired effect could be achieved by adding a friction brake to a conventional governor. Such an arrangement, however, would result in hysteresis, since the governor would then stop the steam supply at a turbine speed much higher than that at which the supply is renewed. This, again, would be undesirable. The device here illustrated provided the necessary speed control.

In the schematic diagram of the mechanism (Fig. 1), a rigid bar is shown with weights *A* attached to each end. The bar is free to turn and is mounted on the main shaft *B* by means of a short shaft *C*. This short shaft is carried perpendicular

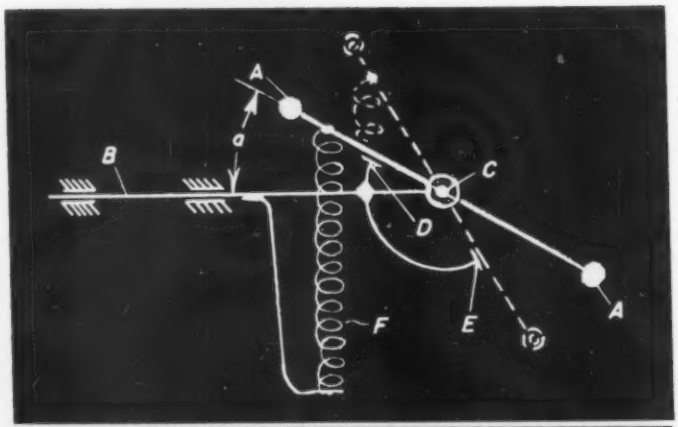


Fig. 1. (Above) Schematic diagram illustrating the principal design features of a quick-acting centrifugal governor.

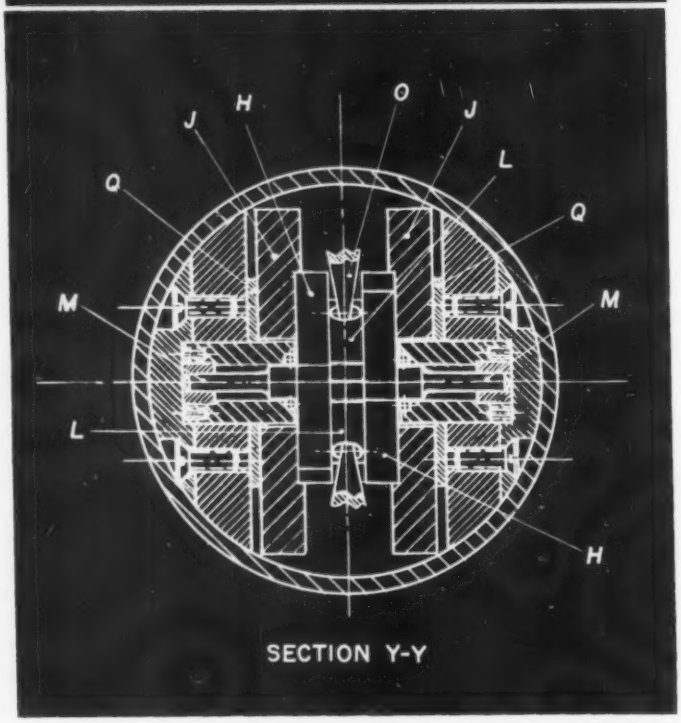


Fig. 2. (Right) View of the actual governor at vertical Section Y-Y taken as shown in Fig. 3.

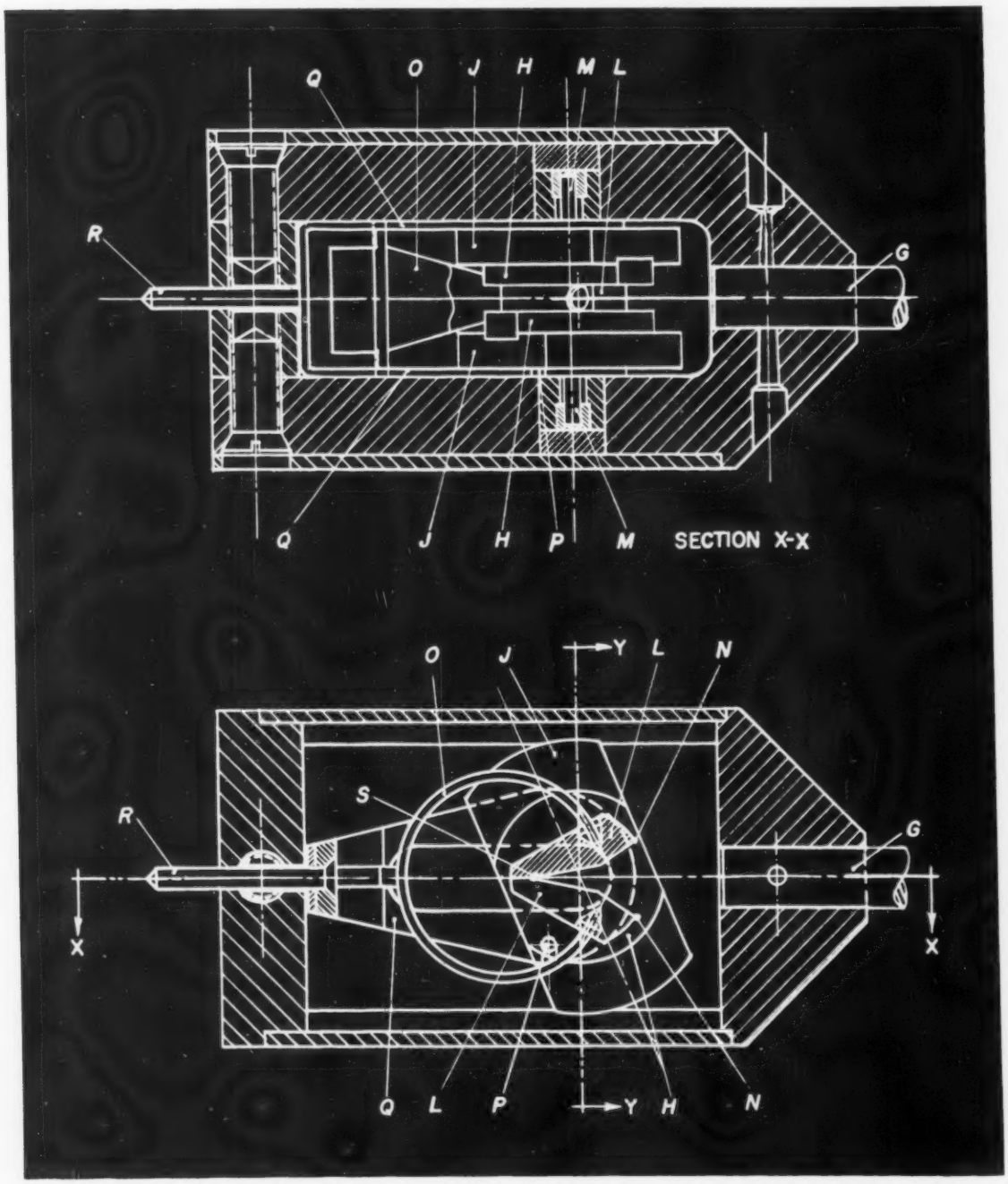
to shaft B. Since a full revolution of the bar about shaft C is unnecessary, stops D and E are employed. A spring F is attached at one end to the bar as shown, and the other end is secured to a rigid support fixed on shaft B.

The centrifugal force f that acts on the mass m of weight A as shaft B rotates at a speed of n rpm is given by the following equation:

$$= m\,(r \sin a)\left(2\pi \frac{n}{60}\right)^2$$

$$f = m\,r \sin a \left(\frac{\pi n}{30}\right)^2$$

Fig. 3. This governor represents a practical application of the design shown in Fig. 1. In operation, the entire device rotates on the turbine shaft, and pin (R) provides the output.



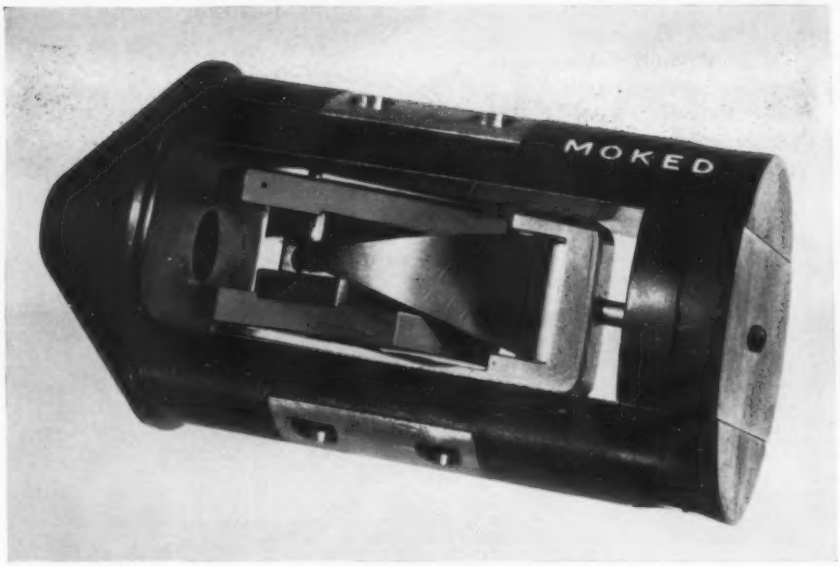


Fig. 4. Here, the actual governor is seen as it appears in the rest position. Output pin, indicated by (R) in Fig. 3, has been withdrawn into the right-hand end of the governor frame.

where

r is the radial distance between the center of rotation of the bar and the center of gravity of the weight, and

a is the included angle between the bar and shaft B.

This force produces a torque on the bar, the lever arm of which is $r \cos a$. Since there are two weights A, the total torque T_A produced is

$$T_A = 2f(r \cos a)$$

$$= 2\, m\, r^2 \sin a \cos a \left(\frac{\pi n}{30}\right)^2$$

$$= m\, r^2 \left(\frac{\pi}{30}\right)^2 n^2 \sin 2a$$

In an actual mechanism, the weights and the bar consist of an infinite number of elemental masses, and the total torque T_A will be the integral of the elemental torques these masses produce, or

$$T_A = K_A\, n^2 \sin 2a$$

where

K_A is a constant depending on the weight and shape of weights A and the bar.

The opposing torque produced on the bar by spring F is obtained in similar fashion. This spring is constructed in such a way that it is not under tension when angle $a = 0$. In Fig. 1, the extension of the spring is

$$r_f \sin a$$

where

r_f is the radial distance between the center of rotation of the bar and the point at which the spring is secured to the bar.

The force exerted by the spring is $cr_f \sin a$ where c is the spring constant of member F. Therefore, the torque T_f applied by the spring on the bar is given by the equation:

$$T_f = cr_f^2 \sin a \cos a$$

In the actual governor (shown in Figs. 2 and 3) the spring exerts pressure on two bars. Thus, when each rotates through an angle a, the expansion of the spring will be

$$2r_f \sin a$$

and the torque on the bars will be

$$2\, cr_f^2 \sin a \cos a, \text{ or}$$
$$cr_f^2 \sin 2a$$

since the term cr_f^2 is a constant, it can be expressed as K_f, and thus

$$T_f = K_f \sin 2a$$

In this manner the device is arranged so that the torque produced by the spring depends on angle a in the same way as the torque produced by the centrifugal force acting on the weights. Therefore, as long as

$$K_f > K_A n^2$$

the bar is held by the spring against stop D (angle a is at minimum value), but when the rotational speed n increases, $K_A n^2$ increases as the square of the speed until

$$K_f < K_A n^2$$

Then, regardless of the angle, the torque produced by the centrifugal force on weight A will exceed the torque produced by the spring, causing the weighted bar to almost instantly rotate from D to E (maximum value of angle a). When $K_A n^2$ becomes smaller than K_f, the bar will just as rapidly move back to stop D.

The rapid movements are due to the fact that n is squared in the $K_A n^2$ term, and therefore every rise and fall in the speed of the turbine causes a fast increase or decrease of $K_A n^2$ as compared with K_f. The critical speed at which the bar changes position is determined by the shape and weight of the bar and weights *A* and by the spring constant *c*. The energy for the movement toward stop *E* is supplied by the kinetic energy of the turbine, while the return movement is energized by spring *F*.

When translating the mechanism shown in Fig. 1 into a practical application, three conditions must be met:

1. The weights in the arrangement (Fig. 1) must have opposite counterparts to make it dynamically balanced and thus prevent the centrifugal force from tending to bend shaft *B* and causing vibrations.
2. The support for the spring must move parallel to shaft *B* in order to permit proper application of spring tension to the bar as angle *a* changes.
3. A means of obtaining the output must be provided.

The actual governor, shown in the actuated position in Fig. 3 and at rest in Fig. 4, is designed so that the entire mechanism rotates on the main shaft *G*. To achieve dynamic balance, two crossed, weighted bars are employed, each of which is formed of two parts: *H* and *J*. Part *H* is made of steel and has a protrusion *L*. Member *J* is made of brass and serves as the weight. These weights revolve opposite each other and are placed in such a way that after a short rotation about shafts *M* in either direction, the protrusions *L* contact each other at points *N* (or S) and do not allow any further rotation in that direction. Parts *H*, *L*, and *M* are machined from one piece of steel.

One end of a spring *O* is set into a depression in each member *L*. An imaginary line extending between these depressions will always be perpendicular to shaft *G*, thus satisfying the second condition.

Spring *O* is triangular when viewed as shown in Section X-X. This shape insures an equal distribution of stress through the circumference of the spring. In this way a spring which has linear characteristics and can withstand large deformations in relation to size is obtained.

To translate the rotation of the weights into a linear movement, a pin *P* is fixed on each of the weights *J*. Each pin has a matching groove in a sheet-metal part *Q*. When the critical speed is exceeded, members *H* rotate against the torque provided by spring *O*, moving parts *Q* outward. Members *Q*, in turn, move an actuating pin *R*, welded to them, outward.

Similarly, when the speed of the turbine slows, spring *O* returns parts *H*, which then contact each other at points *S*, and pins *P* pull parts *Q*, and thereby pin *R*, inward. In Section X-X only one of the pins *P* is seen, as the second is fixed to the underside of the upper weight *J*. Pins *P* move parts *Q* in the same axial direction, whereas weights *J* revolve in opposite angular directions.

The inner ends of shafts *M* are supported on ball bearings to reduce friction. Sleeve bearings are used at the other ends, as the loads there are smaller. Shafts *M* are also provided with hardened steel covers which absorb the centrifugal pressure in the direction of their axis.

Since it was not required, no provisions were made in the governor shown for adjustment of the critical speed. Critical-speed adjustment can be easily accomplished, however, by arranging weights so that their distance from shaft *M* can be varied. This governor, which has been produced by Moked, Haifa, Israel, can also be effective in automatic gearing and other similar speed-control equipment. An important feature of the device is its almost instantaneous action, which reduces hysteresis to a minimum.

Film Gives Useful Hints for Machining Stainless Steel

The shopman's approach to machining stainless steel is shown graphically in a new sound film sponsored by Armco Steel Corporation, Middletown, Ohio. Entitled "Machining Stainless Steels —Part II," the new release is full of helpful hints on turning stainless in automatic lathes. It stresses the practical aspects of complex, high-production machining from the manufacturing engineer's viewpoint. The film is 16 millimeters, black and white, and running time is one-half hour.

There is very little advertising in the film, and even this is pitched low. Instead, its writers and editors have packed it full of unusually helpful short cuts for increasing productivity and quality, or else cutting down rejects and setup time. Program committees of engineering society chapters, and others interested, can secure the free loan of film copies by letterhead request from the Jam Handy Organization, 2821 E. Grand Blvd., Detroit 11, Mich.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Compound Rest Adjusts Lathe Tool to Diameters Dimensioned in Metric System

H. J. GERBER, Stillwater, Okla.

When the compound rest of a lathe is set at an angle of 23 degrees 11 minutes, each 0.001 inch of movement of the compound rest along its axis produces 0.01 millimeter of movement perpendicular to the lathe center line. This principle can be used to adjust a tool to a diameter dimensioned in the metric system.

Proof of the angular adjustment of the compound rest is explained by the diagram, Fig. 1.

Since 0.01 millimeter = 0.0003937 inch,

$$\sin \alpha = \frac{0.0003937}{0.001} = 0.3937$$

therefore

$$\alpha = 23 \text{ degrees } 11 \text{ minutes}$$

A sine bar can be used to adjust the compound rest accurately, as in Fig. 2. After the right side of the compound rest is machined parallel to its dovetail slide, a plate is fastened to it. A 10-inch sine bar is then clamped to the plate. Using a cylindrical test bar between the lathe centers, the compound rest is swiveled until it is at the required angle of 23 degrees 11 minutes. This is obtained by placing gage-blocks between the sine-bar plugs and the test bar. The center distance of the plugs is 10 inches; so one plug has to be 3.937 inches farther from the test bar than the other plug.

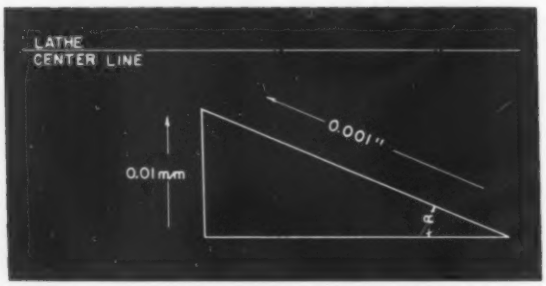


Fig. 1. (Above) When angle α = 23 degrees 11 minutes, a movement of 0.001 inch of the compound rest produces a movement of 0.01 millimeter (0.0003937 inch) relative to the lathe center line.

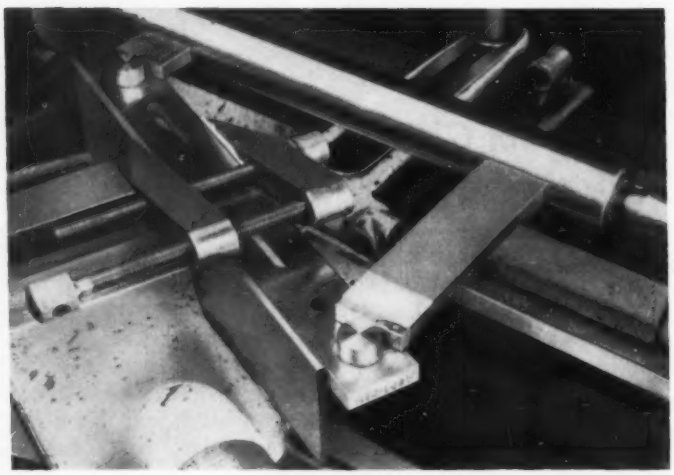


Fig. 2. (Right) Here, a 1-inch gage-block has been placed against one sine-bar plug (for clearance), while the stack of gage-blocks against the other plug equals 4.937 inches, to obtain a difference of 3.937 inches.

Novel Gage Checks Internal Grooves

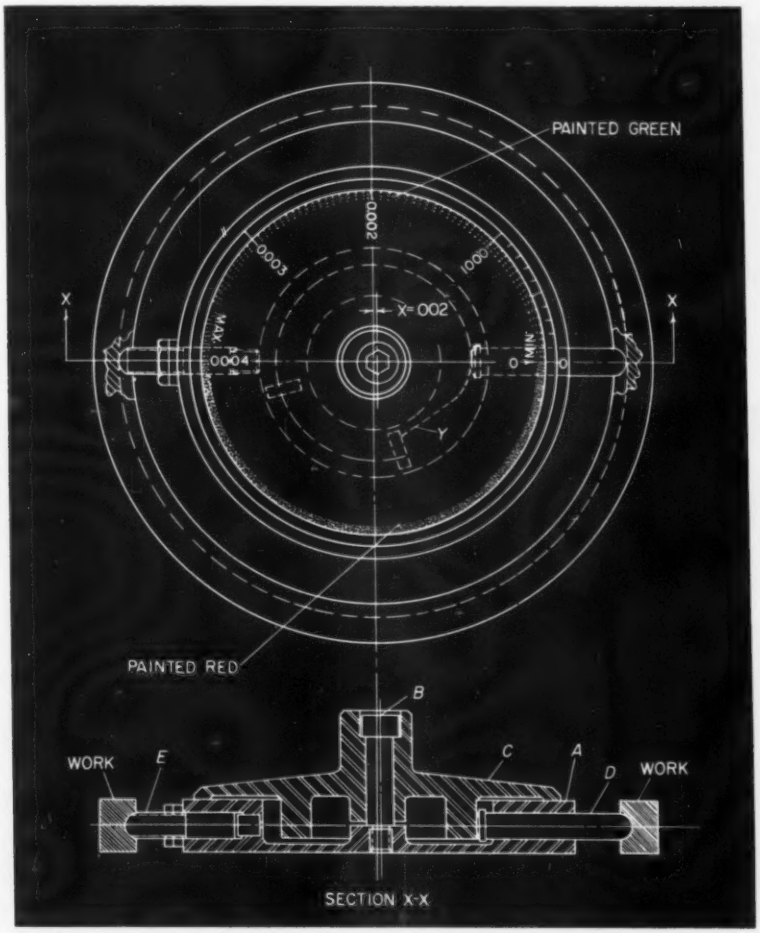
CHARLES M. BARTLETT, Birmingham, Ala.

Capable of exceptionally fine gaging, a device (see sketch) whose principle can be used for inspecting outer ball-bearing raceway grooves and a variety of other internal bores has been built for use in a valve-making plant. The raceways are 4 inches and over in diameter and are components of large gate valves. Different diameters having the same tolerance can be set up by changing the adjustable pin on the left in the sketch. The tolerance can be changed by shifting the dial center hole a calculated distance to the right of its true center.

The gage consists of four machined parts: a base *A*, a dial *C*, and two pins *D* and *E*. The dial *C* (see drawing) is bored 0.002-inch off-center for the fillister-head screw *B*. The eccentric dimension can be a value equal to or less than the full tolerance of the work part. The dial itself is calibrated after assembly, using a micrometer. Thus, the eccentric dimension is not critical. The gage in the sketch is calibrated for a 0.004-inch tolerance. In practice, simple minimum and maximum marks are usually satisfactory for production inspection purposes.

The illustration shows how large rotary movements of the dial *C* act in the manner of a cam on the sliding pin, which acts as a follower. The pin is pushed outward in extremely small proportional amounts. As an aid in centering the work in the device, there is ample room to add spring-loaded pins at 30 degrees on either side of the adjustable pin *E*.

This same operating principle can be applied to depth-gaging devices, with the advantage that they are much easier to read than regular flush-pin gages.



Simple gage for bore grooves, such as ball-bearing outer races, gives fine measurements that are easy to read quickly.

Two-Station Die Set Makes Difficult Bend Easy

ROGER ISETTS, Kenosha, Wis.

An air-duct baffle, formerly difficult to bend, was produced easily through the use of a novel two-station die. The baffle consists of a pair of right angles folded back-to-back making a rib, Fig. 1. When the press tools were first considered, it was thought that two or even three separate operations would be required to form the rib.

The dies that were built, Fig. 2, turned out to be extremely simple in design. They have proved effective and trouble-free. Toolroom maintenance cost and part rejects have been much lower than under normal expectations. After the first work-blank receives the first bend on the left-hand portion of the die, it is moved to the position at the right while a new blank is placed on the left-hand tools. Thereafter the operator takes a finished part from the right-hand dies, transfers a part from the left-hand set to the right-hand tools, and puts a blank in position on the left-hand tools.

The left-hand die set, shown fully shut in Fig. 2, produces a 30-degree V-bend. A properly developed blank is laid on top of die-block *A*, positioned by three locating dowels *B*. Hardened punch *C* does the forming. It is built as an insert, making replacement easy. The tops of a pair of spring plunger pads *D* in the lower member are normally flush with the top of the bottom die-block. They hold the stock against the punch on the bending stroke and also serve to eject the work. Simultaneously, four spring-loaded pins *E* strip bent parts from the punch.

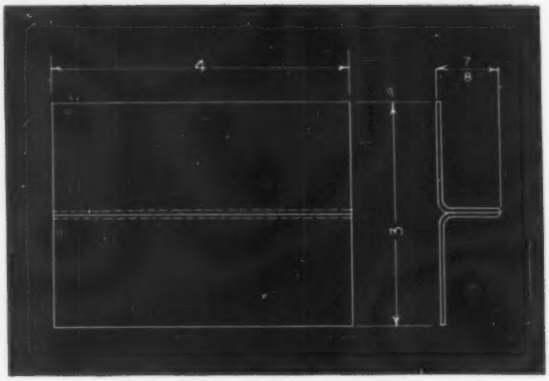
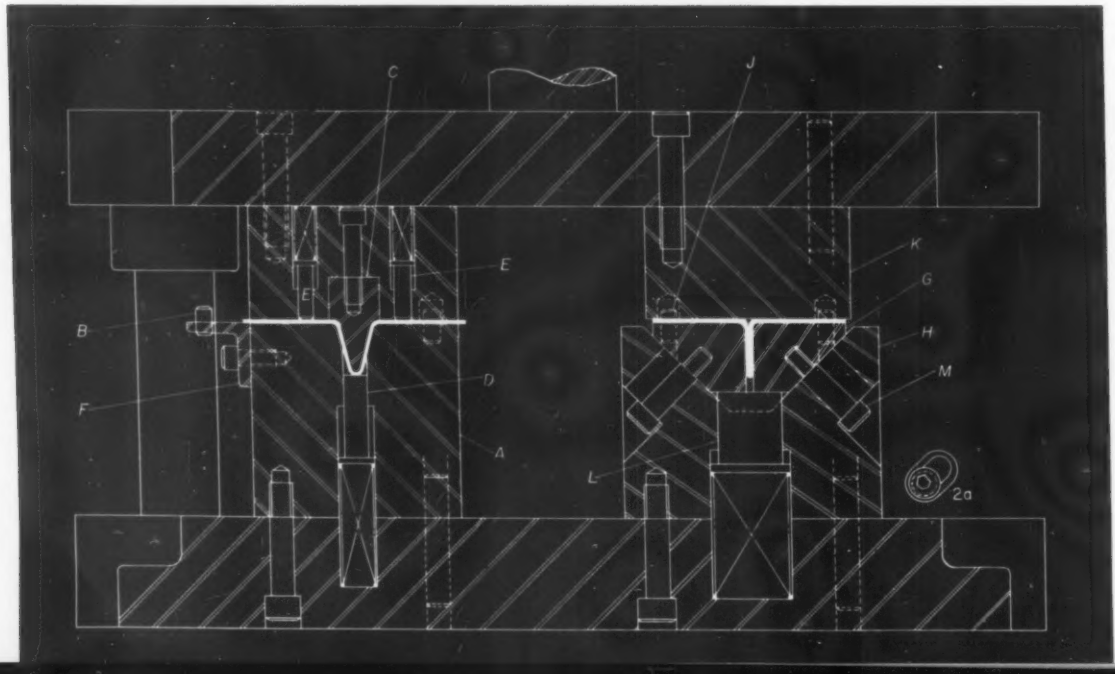


Fig. 1. The work-piece is a baffle for air ducts with the finished dimensions shown. It is 18-gage (0.048-inch-thick) sheet steel, hot rolled, pickled and oiled, and starts out as a blank approximately 4 by 5 inches.

A length of standard angle stock *F* is bolted to block *A* to support two locating dowels.

At Station 2 on the right, Fig. 2, the partially formed part nests between a pair of cam-blocks *G*. These are hardened tool steel. They ride in lower V-block *H*. Work is positioned at the back against dowels *J*. When the punch block *K* descends on the work, the pressure forces the cam-blocks downward and toward each other, pinching the vee of the work into a tight rib, under compression from spring plungers *L*.

Fig. 2. This view shows the dies for the air-duct baffle rib-forming operation fully closed on work at both first and second stations. On the right, the cam-blocks have forced the vee of the work-piece into a tight fold. Travel of the cam-blocks is limited by the shoulder-screws (M). On the up stroke of the ram the cam-blocks open to free the work. The inset (2a) shows one of the shoulder-screw slots that guide the cam-blocks.



LAUNDRY-TUB MAKING INVOLVES VERSATILE PRESSWORK

L. DeMARTINI, Press Shop Manager
Ingersoll Products Division
Borg-Warner Corporation
Chicago, Ill.

SPINNER TUBS for Norge automatic home laundry washing machines are important high-volume production items of the Ingersoll Products Division, Borg-Warner Corporation. These tubs differ from those in other washers in that the radial water-extraction hobs are in a single row in a necked ring which is welded to the top.

The tub proper and the ring appear separately in Fig. 1; Fig. 2 shows them together. During the washer's spinning cycle, centrifugal force causes the water to flow out of the radial holes. Embossed flutes around the outer lip of the ring provide passages for the extracted water. After the assemblies are shipped to the Norge plant in Herrin, Ill., a circle of concrete, used for balancing purposes, is poured into the channel flange of the ring.

The tub is drawn from a round blank of cold-rolled steel, 35 inches in diameter and 0.050 inch thick. Drawing and restrike are combined on a double-action, 1200-ton press, Fig. 3, equipped with two dies. The draw, 10 7/8 inches deep, wipes the sides, leaving a generous radius and a flange at the top. In the restrike, a recess is formed in the bottom and the radius at the top is greatly reduced.

Another press (Fig. 4) then blanks out a large opening at the center, pierces forty-one small holes and five larger mounting holes around the opening, and trims the flange, which is left quite narrow. When the press operator removes the tub from the die, he sets it over a fixture (seen in the foreground) having at the top two power-driven rotary wire brushes. They rotate the stamping slowly and remove all interior burrs around the holes just pierced, leaving the bottom smooth.

The necked rings are produced from 24 1/4-inch square blanks of 19-gage stock. Each blank first is automatically roller-coated with a drawing compound, then enters the 300-ton press seen in the heading illustration. This press draws a circular boss about 2 1/2 inches high, pierces a 7-inch opening in the center, and leaves a wide flange trimmed to circular shape.

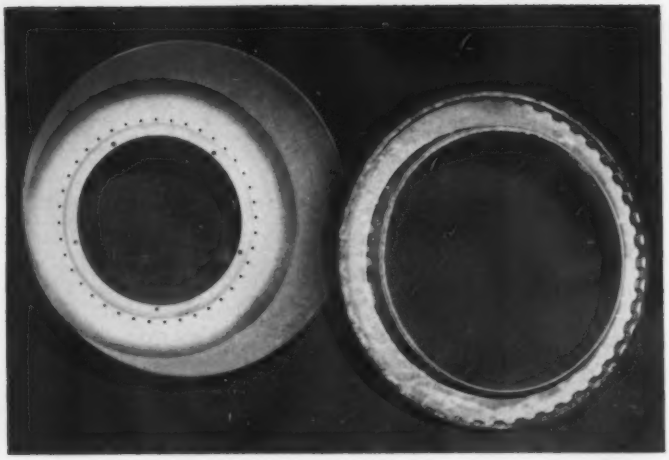


Fig. 1. The spinner tub proper (left) and necked ring after all press operations on both have been completed.

When this "hat" is next placed in an inverted position in another press, Fig. 5, a punch wipes the lower sides of the boss downward and shears out the opening to a diameter of about 14 inches. At the same time, the outer portion of the punch embosses the flutes by forcing metal inwardly into mating recesses of the die. These operations give the flange a channel section, the inner leg of which is at an angle rather than being drawn straight, as is the remainder of the neck. After the punch is retracted, an air-operated cushion lifts the stamping off the die flutes.

Fig. 2. (Above) Spinner tub and ring assembly. Flutes around ring form spot-welding points inside tub wall.

Fig. 3. (Left) Tub held by operator has been drawn in first press position. The inverted tubs underneath have also been restruck.

In a subsequent press operation, the metal rim surrounding the flutes is trimmed to size and wiped down to form a 3/4-inch lip. A cam portion of the upper die then forces forty-five small punches to move out radially to pierce the row of holes in the ring. In the fourth and final press operation, the end of the neck is curled outwardly, and the 3/4-inch lip is curled over the top of the flutes.

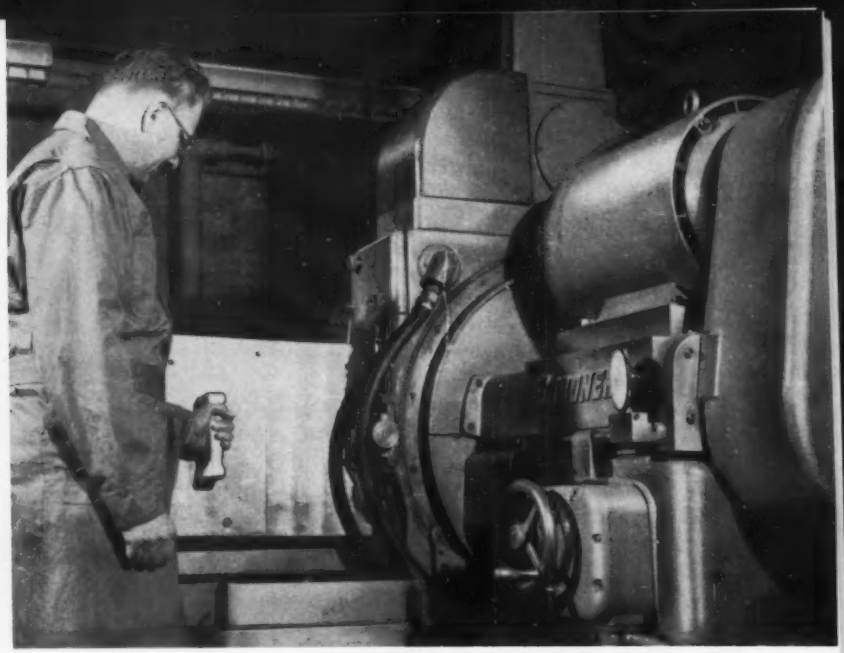
It then remains to join the ring and tub by spot-welding each flute contact point. After the ring is seated in a fixture, the tub is placed over the flutes. There are fifteen electrodes positioned radially around the fixture, operating simultaneously. Since forty-five flutes are to be welded, the fixture has three positions of index. The assembly is now ready for cleaning and vitreous enameling.

Between the spinner tub and the washing-machine housing there is an outer tank, also produced in the Ingersoll plant. The bottom of the tank is its major stamped component, since the walls are of resistance-welded flat sheet.

The first press operation on the bottom consists of drawing a side sump recess and a small central recess. A second press draws a flange, embosses three radial stiffening ribs, pierces a central hole, and trims the flange corners. After a third press does further forming and adds more stiffening ribs, a hole is pierced in the sump and the central area is restruck for flatness, in a final operation.

Fig. 4. (Above) Wire-brushing rig in foreground deburrs all the holes pierced in this press operation.

Fig. 5. (Left) Embossing the flutes in the ring involves severe forming, but ample radii in corners are provided to avoid tearing the metal.



Double-Disc Grinding Proves Boon to Instrument Making

CHANGING from the machining method conventionally employed to a hitherto untried one is a difficult step for an established shop to take. Normally, the tendency is to continue with the proved way of doing things. However, extra-close tolerances, such as those required of parts for missile-tracking computers, often have the effect of slowing down production. When this occurs, a fresh approach to metal removal is frequently necessary if precision parts are to be made in volume at a reasonable cost.

An example of how a re-evaluation of a machining method can be profitable was recently experienced by a leading manufacturer of precision instruments. In the change-over, a single Gardner double horizontal-spindle disc grinder has been set up at the Ford Instrument Co. division of Sperry Rand Corporation, Long Island City, N. Y., for the machining of aluminum plates. These plates, which are for a gear-box housing used in missile computers, are being face-ground at ten times the rate previously attained on more extensive equipment by another machining method.

In addition to a saving in costs, accuracy has been improved and rejects greatly reduced. The gear-box involved was designed to house gears, shafts, potentiometers, and resolvers used in computers for the United States Navy's Tartar and Terrior missiles. Tolerances on the gear-box require that three of the 3/16-inch thick aluminum walls be flat and parallel to within 0.003 inch. The facing operation is made difficult by the fact that the plates may be as large as 14 by 18 inches.

After the Gardner grinding machine was installed, the right disc specifications, wheel dressers, coolants, and alignment settings were experimentally determined. The main problems

Fig. 1. These gun type work-holding fixtures are used to nest various shaped parts during processing on a double-disc horizontal-spindle grinding machine.

Fig. 2. This brass master cam has been precision-ground by double-disc grinding in about three hours. Formerly, two days were required by a skilled technician to hand-scrape the cam.

encountered were to maintain constant wheel settings and to prevent the coolant from heating so rapidly that the aluminum would warp. These problems were readily solved, and the best operating procedures developed.

In a typical operation (heading illustration) an aluminum plate is inserted by the operator in a hand-operated roller gun type fixture. This sliding fixture, which travels on precision rollers, carries the work between two opposed grinding discs. Gun type work-holding fixtures for various shaped parts are illustrated in Fig. 1.

Because the part is free-floating between the two discs, rather than being clamped, it can be ground on two sides simultaneously. This simple principle contributes to the accuracy attained on the finished part. Tolerances attained are within 0.0005 to 0.001 inch for flatness and parallelism. Loading the work in the holding-fixture blade requires only a few seconds.

Since double-disc grinding has proved efficient for mass-producing aluminum plates, the process is now employed at the company for similar parts where flatness and parallelism are critical. As an example: the machine is used to grind brass cam masters, such as the one shown in Fig. 2, in about three hours. Formerly, a skilled technician required about two days to hand-scrape a master cam of this type, machine it, and check it. Various parts that have been produced by the company on the Gardner double-disc grinding machine are shown in Fig.3.

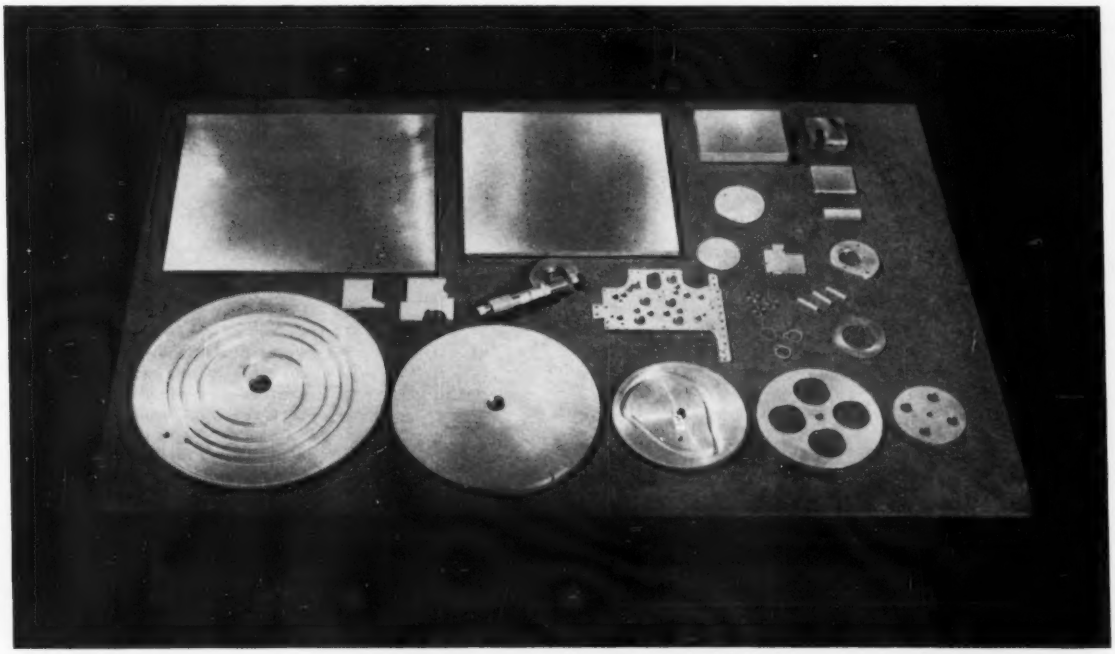


Fig. 3. Instrument parts that were precision-ground on the double-disc grinder shown in heading illustration.

Paul B. Schubert

NEW MATERIALS

The properties and new applications of materials used in the mechanical industries

Chromium-Nickel Alloy Performs Its Function at 2300 Degrees F.

A furnace-hearth grid assembly made of "Supertherm," a patented alloy of the Electro-Alloys Division of American Brake Shoe Co., Elyria, Ohio, supports rocket-engine parts during a brazing cycle of five to eight hours, operating in a temperature range of 1800 to 2300 degrees F. The alloy contains 26 per cent chromium and 35 per cent nickel, and is strengthened and stabilized with cobalt and tungsten.

Circle 565 on Readers' Service Card

Long-Life, High-Speed Steel for Hard-to-Cut Metals

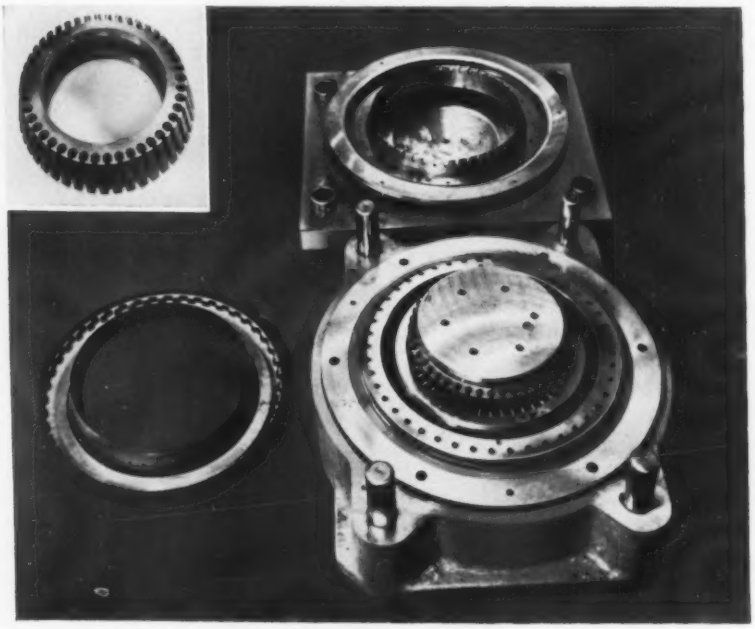
The Crucible Steel Company of America, Pittsburgh, Pa., has developed a grade of high-speed steel which provides good tool life in machining hard-to-cut metals. The steel, designated Rex 49, cuts such materials as highly alloyed steels at high hardness levels, stainless steels, superalloys, and titanium. The steel can be heat-treated to 67 to 69 Rockwell C. It can also be used in the cutting of more normal materials at increased speeds, feeds, and depths of cut.

Circle 566 on Readers' Service Card

Clear, Flexible Silicone Potting Material for Electronic Assemblies

A clear silicone potting and embedding compound that provides mechanical and dielectric protection for electronic components and assemblies has been brought out by the Silicone Products Department of General Electric Co., Waterford, N. Y. Called LTV 602 (low-temperature vulcanizing) clear silicone potting compound, it cures at 70 to 80 degrees C. to a flexible, resilient solid.

The material provides protection against shock, vibration, moisture, ozone, and corona. Because



The washing-machine spinbasket collar containing forty-five punched holes shown at lower left was made in this tooling setup, an essential part of which is a cam-ring (see inset upper left) made of Carpenter Vega (AISI Type A-6) air-hardening tool steel. This steel, made by Carpenter Steel Co., Reading, Pa., was selected because it moved out of round less than 0.001 inch over-all in heat-treating operation.

Circle 567 on Readers' Service Card

of its low viscosity in uncured form (800 to 1500 centipoises), it flows freely in and around complicated parts. Delicate parts are not damaged by stress during cure. The material is designed to meet the thermal-shock requirements of MIL-STD-202A, test condition B, which specifies 5 cycles from 65 to 125 degrees C. It can be used for complete water immersion.

Circle 568 on Readers' Service Card

Water-Soluble, High-Film-Strength All-Purpose Machining Compound

Baker/Gubbins Co., Detroit, Mich., has brought out a machining compound which possesses high film strength, good wetting ability, and corrosion-prevention characteristics. Along with these properties, which make it suitable for a variety of operation on metals, are also nontoxicity; a mild, pleasant odor; and immunity to bacterial action.

B/G No. 576, as it is called, is especially adaptable to large central systems, due to its property of rejecting "tramp" oils (which will float and may be skimmed off the top of the tank) and its low "drag out" on parts being machined. It has been used in spline rolling, broaching, and similar applications.

Circle 569 on Readers' Service Card

Process for Applying Protective Tin Coating by Dipping

A chemical process for depositing a protective tin coating on metal surfaces has been made available by Shipley Co., Inc., Wellesley, Mass. Called Cuposit LT-26, the chemical produces a stable solution which is used to produce a coating by dipping. The process is said to offer these advantages: it operates at temperatures much lower than those for the hot-tin dip process, does not require the use of electricity, and contains no cyanide.

The coating is used on printed circuits, eyelets, connectors and plugs, component leads, and other electronic hardware. It can also be used for whitening copper, copper-based alloys, lead-tin electroplate, and other materials.

Circle 570 on Readers' Service Card

Casting Process for Titanium Pumps, Valves, and Fittings

The development of a method for casting small titanium parts in production quantities has been announced by Titanium Metals Corporation of America, New York City. Called Impel Casting, this method of casting small titanium parts—such as pump housings, impellers, valve bodies, fittings, and pump sleeves—uses permanent molds capable of producing forty castings per mold. Titanium is virtually immune to corrosion in environments such as wet chlorine, nitric acid, hypochlorites, urea, and inhibited sulphuric acid. The yield strengths in cast products range from 25,000 to 100,000 psi, depending on the grade of titanium used.

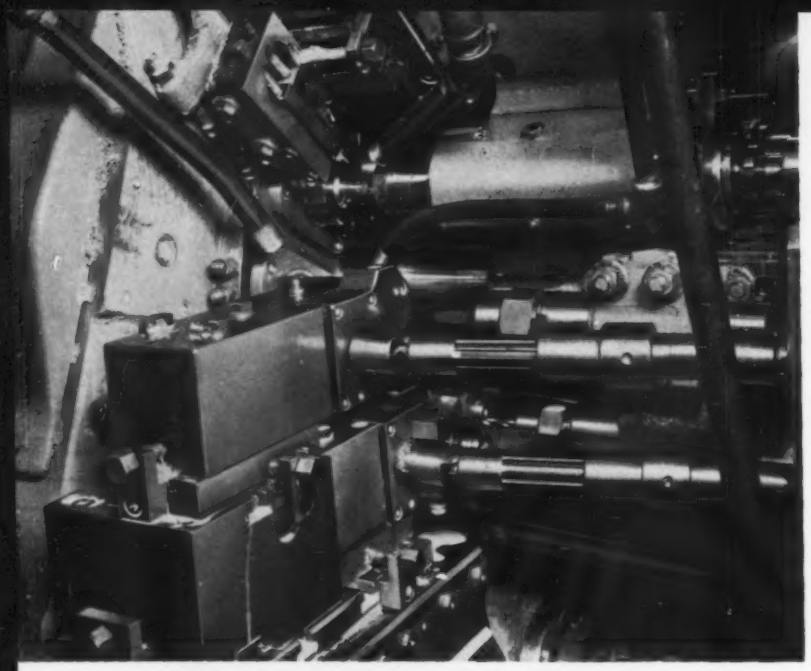
This 9-inch impeller was "Impel Cast"—a casting method employing permanent molds being used to produce parts such as titanium pump housings, valve bodies, fittings, and pump sleeves.

Circle 571 on Readers' Service Card

Heavy-Duty Cleaner Developed for Removal of Soils by Immersion

Oakite Products, Inc., New York City, has introduced a compound designed expressly for the removal of heavy and tenacious soils by immersion. The material, called Oakite HD 126, has a pH of 13.5 in the recommended solution concentration. It contains no rosin or soap and is said to be completely rinsable. The compound is safe on steel, brass, and magnesium; but it is not recommended for use on aluminum and zinc. It is also said to have applications in barrel cleaning before plating operations, and for cleaning before vitreous-enamel finishing. The cleaner is particularly recommended for use in hard-water areas.

Circle 572 on Readers' Service Card



An open tooling zone and independently operated tool-slides permit synchronization of stencilling, knurling, and broaching attachments to eliminate a number of secondary operations

Versatile Tooling Produces Complex Razor Part on One Automatic

FRANK BRANSTROM, Tooling Specialist
National Acme Co.
Cleveland, Ohio

THE ADVANTAGES of an open tooling area and independently operated tool-slides combined with the precision and flexibility of direct camming have permitted an ingenious job of tooling for an important part of a safety razor. Versatility of the setup permitted close synchronization of stencilling, knurling, and broaching operations.

The work-piece is one of a series of precise components machined on 9/16-inch capacity Acme-Gridley six-spindle automatics. Many operations that formerly were secondary are now done in the primary setup. For example, nine numbered positions are stencilled on a turned portion of the periphery of the part (Fig. 1), and interrupted knurling is held in exact location on the circumference relative to the marking. In addition, close-tolerance holes are produced and all external burrs are removed. Accomplishing such operations in the primary setup, of course, eliminates costly rehandling of the parts and reduces need for secondary machining equipment.

In all, thirteen operations are successfully performed in a four-and-one-half-second cycle. Production capacity of the machine is 800 pieces per hour, and there is a minimum number of rejects. With proper care, net production (taking into consideration tool changes, loading, and other routine tasks) consistently averages 75 per cent of capacity. All surfaces require a micro-inch finish of sufficient smoothness to prepare the part for automatic numeral filling and wiping and plating operations.

The work-piece is produced from 5/8-inch round free-cutting brass bar stock, specially heat-treated for rolling. The spindles rotate at 2140 rpm to provide a cutting speed of approximately 300 fpm for most operations. A series of special machine features were necessary for proper tool functioning and for obtaining the finish required. For example, the stencilling, knurling, and broaching attachments had to be synchronized within 0.1 degree. Synchronization was accomplished by gearing the spline drive shaft for these attachments to an exact speed ratio with the spindle.

The bar material is fed to an automatic stop in the sixth (loading) position. Here the part is finish-turned to a tolerance of 0.001 inch with a circular type form tool tipped with tungsten carbide. This tolerance is necessary for subsequent operations. A 3/8-inch diameter hole is also drilled partially through the work-piece at this station.

After the spindle-carrier indexes to the next (first) position, the numerals are stencilled with a roll that is three times the diameter of the part. A 25-degree cross-slide cam advances the stencil roll, permitting it to contact the part for three revolutions of the work-piece. Therefore, in order to provide one complete revolution of the roll, the spline-shaft drive from the gear-box is operated at one-third of the spindle speed. In the same spindle station, the remaining portion of the hole is drilled to a 1/4-inch diameter.

Knurling, in the second position, is also performed with a tool having a diameter three times that of the part and driven by a spline shaft at one-third of the spindle speed. In addition to the knurling, the part is rough-counterbored at this station. The stencilling and knurling attachments are stacked on the first-position slide as seen in the heading illustration.

Broaching with an external, hydraulically operated attachment is accomplished in the third position. This attachment, mounted on an independently operated cross-slide, advances and retracts to cut away four of every seven teeth, and thus produces an evenly spaced effect. At the same time, a V-slot opposite the numeral five is broached internally. Hydraulic operation of the broach is actuated from trip-cams on the front drum of the main camshaft.

In the fourth station, the part is shaved all over and any knurling or broaching burrs are removed. The hole is also reamed and counterbored with a three-stop tool. The two operations at this station

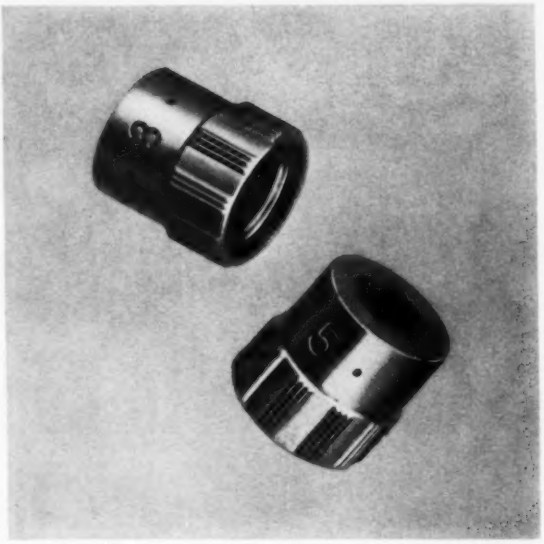


Fig. 1. Complex safety-razor part that is completed in thirteen operations on a single six-spindle automatic bar machine.

are performed in order to produce exacting finishes. Of particular importance is the micro-inch finish required on the periphery to permit automatic filling and wiping of the numerals after plating. In the fifth and final position, the piece is tapped, cut off, and dropped into a chute leading to a finished-parts container. Tooling for the fourth, fifth, and sixth positions is seen in Fig. 2.

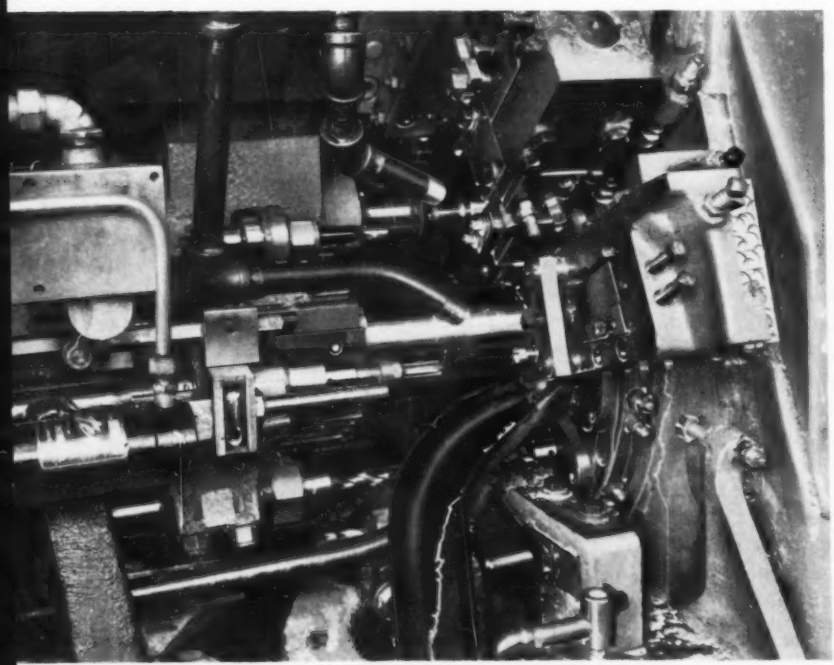


Fig. 2. Tooling used in the fourth (top), fifth (center), and sixth (bottom) positions. Part is tapped and cut off in the fifth position, whereas loading and initial form turning and drilling occur in the sixth.

C. DANA MOORE
Manager of Application Engineering
Thomson Electric Welder Co.
Lynn, Mass.

You Can . . . Flash-Weld Aluminum to Copper If You Have the Proper Tools

Once considered impractical, the flash welding of aluminum to copper is rapidly becoming a routine process in many plants. Acceptance of the method has taken a long time, principally because it awaited the development of methods to synchronize the heat and force cycles with satisfactory repeatability

ANY flash-welding machine designed to weld aluminum to copper must compensate for characteristics in each metal which are, by their nature, detrimental to the process. Of these, three are most important: (1) the rate of thermal conductivity of each metal, (2) the resistance to electrical current in each metal, and (3) the temperature range corresponding to the plastic state of the metals.

The efficiency of a metal in dissipating heat (its thermal-conduction rate influences its weldability drastically. If the metal holds heat relatively well, it can be made to flow quicker and thus can be resistance-welded much more rapidly than one that has a lower ratio of thermal conductivity. Unfortunately, both copper and aluminum are excellent heat conductors—copper somewhat better than aluminum. Electrical current for resistance welding, therefore, must be intense and synchronized with extreme accuracy. Furthermore, to weld properly, the welding machine must incorporate a means of equating the differences in the conductivity of the two metals.

Compared with low-carbon steels, the electrical conductivity of aluminum is high. That of copper is even higher (see table). Although this property is obviously the reason these metals are preferred for electric-power transmission, it is detrimental to easy flash welding because of the difficulty of concentrating controlled, effective heat in the weld area.

The plastic range of any material is the temperature spread between which a metal is neither totally solid nor completely liquid. Naturally, in the plastic range, metal closely approaches its melting point. In some metals there is sufficient

Electrical Conductivity Ratings of Some Principal Metals (Silver = 100)

Aluminum	63.00	Steel	12.00
Chromium	16.00	Tin	14.39
Copper	97.61	Titanium	14.00
Nickel	12.89	Zinc	29.57

latitude in the plastic range so that, with the application of force, two parts can literally be squeezed and fused together to form a homogeneous and strong joint with ease. With less-compatible metals, however—and aluminum and copper are in this category—the plastic range is narrow; the change from a solid to a liquid state occurs quite rapidly, and force must be applied accordingly. To make matters worse, aluminum begins to flow before copper—witness the comparative melting points of 1220 versus 1981 degrees F.

For many years welding engineers tried to design a flash butt-welding machine that would give an extremely short but intense welding cycle so that the dissimilar parts would be brought up to a plastic state in a fraction of a second. It was recognized that with its lower melting point, aluminum would burn away to some extent, but the amount—when related to economics—seldom was critical. It was also important to know how much copper would burn away, in order to properly design the platens, dies, and die-holders.

It is one thing to know welding criteria for an aluminum-to-copper joint. It is something else to design an efficient flash-welding machine that meets these conditions well enough to produce a strong, sound joint having good production reproducibility. There are as many problems as there are different joint designs (Fig. 1). The solutions to the problems are not always simple—often challenging. Finding the proper heat balance is an example of a relatively simple problem. The variable of heat balance can be controlled by adjusting the distance each part projects beyond the dies so that the cubic volume of each is commensurate with the heat applied and the time cycle. (Theoretically, the shape and size of each part also could be proportioned according to the required heat balance. Unfortunately, other factors preordain that they be approximately the same.)

Timing the application of heat and synchronizing the upset force (so that it is applied at the exact moment each metal is in its most plastic state) are more difficult. Historically, synchroni-

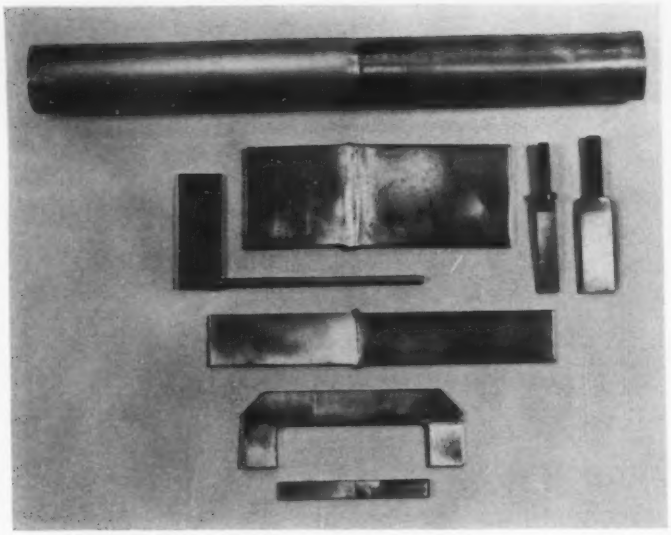


Fig. 1. Typical of aluminum-to-copper joints that are being flash butt-welded are: a ground terminal bar (top), bus bars, screw terminals, and round aluminum stock in solid bars.

zation has been the stumbling block to the successful flash welding of aluminum to copper. Recently the Thomson Electric Welder Co. developed and patented its mechanical system called Synchromatic and supplemented it with an auxiliary upsetting control called Dual Force. This method gives consistent results. A machine with this equipment is shown in Fig. 2.

The goal in flash-welding nonferrous metals is to shorten the time interval between "flash-off" (turning on the heating current) and the application of forging force to the point where the two occur instantaneously and the metals are forged and fused together at the optimum moment (heading illustration). Graphically, the flashing-speed curve is parabolic: there is no interruption or pause while upset-forging force is being exerted. Furthermore, the forging force, ideally, should be applied in two increments—the first for combining the granular structures of the parts; the second for compressing the eutectic sectors and expelling the relatively weak materials at the interface. This sequence insures maximum ductility in the weld, Fig. 3. The Synchromatic mechanism releases stored energy at the exact instant necessary to overcome the inertia of the platens and synchronize flash-off and forge force.

This custom-designed mechanism consists of a hydraulic flow-control valve; a snubbing cylinder; a double-acting, pneumatic push-up cylinder; and a crank and linkages connecting to a movable platen. The mechanical cycle operates in conjunction with a secondary pneumatic system (the dual force) which provides the synchronization so critical to the process. As the term implies, a second forging force transmitted from an auxiliary cylinder to the platen follows in automatic sequence. The degree of force may be varied by means of a solenoid control. Timing is preset in an arrangement of dial controls.

Depending on the coefficient of friction of the parts to be welded, the clamping pressure which must be exerted to hold the work generally is between two and three times that of the forge force. In most aluminum-to-copper applications, the ratio is 2.5 to 1 when the parts are not serrated. Assuming an 18,000- to 25,000-psi upset force, it follows that a complementary clamping system must deliver between 45,000 and 62,500 psi. Thus, sturdy air or hydraulic arrangements are required. Clamp styles are optional, depending on the design of the assembly being welded. An alligator clamp, a horizontal type, and a bridge type are the more common designs employed.

Pinch-off dies contribute much to the efficiency of a flash-welding machine. Developed by this company, these hot cutters automatically scalp expelled material from the weld area and add support to the parts being welded (so that they do not buckle during forging). The dies are mounted on the platens and are adjustable and removable. Immediately following the forging cycle, one die, activated by the automatic mechanism, moves horizontally to seat against a mating stationary member. In so doing, it shears off the flash metal before it cools. This automatic pinch-off operation eliminates over 90 per cent of the usual cleanup grinding and provides a high degree of joint uniformity.

Starting from a few isolated applications using small strips of copper and aluminum, flash butt welding has progressed rapidly in the past few years. Today, bars measuring 1 1/4 inches thick by 3 inches wide are being joined in production

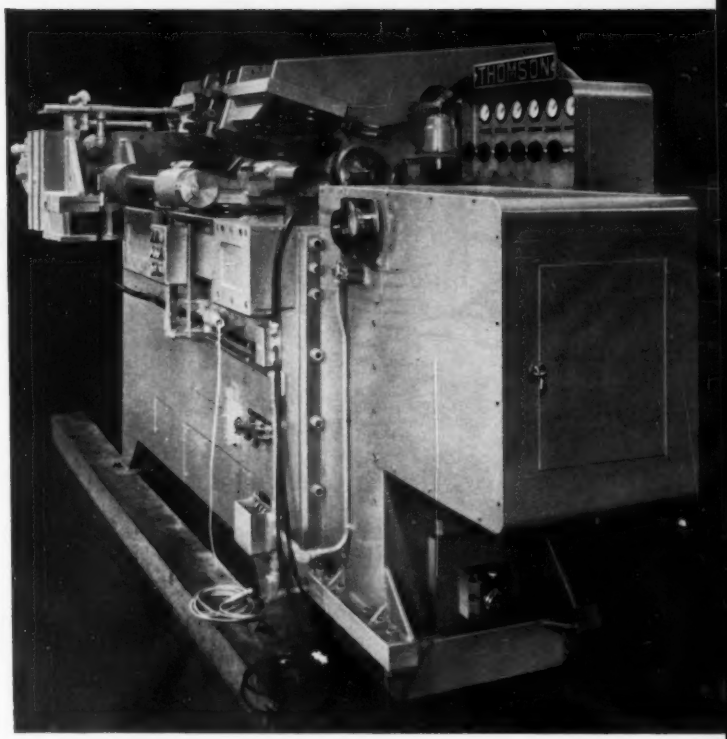
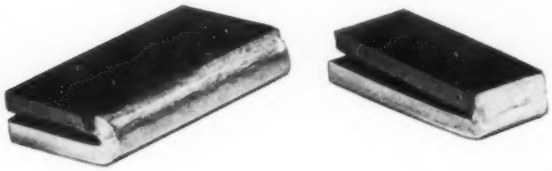


Fig. 2. (Right) A flash butt-welding machine joins copper to aluminum, copper to copper, or aluminum to aluminum. Sections as large as 3/8 by 6 inches can be welded. Upset and forge force are applied by an automatic mechanism enclosed at the right end of the unit, controlling the large air cylinders at the far end.

Fig. 3. (Below) A 180-degree bend test is one of the several inspection methods by which joints are proved. There is no evidence of cracking. In subsequent reduced-section pull tests, the base metal failed before the weld joint.



operations. Tubing also has proved to be capable of being welded by this method. Sizes as small as 5/16 inch in diameter, with a 1/8-inch wall, are being welded successfully. In both cases, specimens subjected to 180-degree bend tests and to reduced-section tensile tests confirm the high weld quality that is obtainable with machines that provide the needed cycling and synchronization.

A principal manufacturer of refrigeration components uses copper and aluminum tubing in making refrigeration condensers and evaporators. The copper section of the unit facilitates subsequent assembly performed by their customers, on installation, because tin-lead sweated connections can be substituted for Heliarc welds. Tubing diameters run 1/4, 5/16, 3/8, and 1/2 inch, and the length of a typical copper section usually is upward of 4 inches. Sweat-soldering a joint to a piece much shorter than 4 inches produces excessive heat dangerously close to the weld. The end of each aluminum piece—whether straight or coiled—is cut at a 10-degree angle to give preferred weld-flash initiation. A burn-off allowance equal to the diameter of the tubing is prescribed for the aluminum section.

One of the numerous machines currently in use is assigned to the butt welding of copper ends on tubing in evaporators. The evaporator sheets are flat, transported on skids to the machine location. The operator merely places the sheet on an apron at the side of the unit to support it during the welding cycle. Then he clamps the ends of the tubing in the unit and starts the welding cycle by push button. All machines are of identical design and equipped with Synchromatic, Dual Force, pinch-off dies, and a "Gapolator." The latter is a mechanism that permits butt-joining the tube ends and automatically gap-positioning the work before flashing. Clamps are of the alligator type and exert 2800 pounds of pressure to hold the work. Every flash weld must pass rigid tests. Pinch-off dies trim external flash during the weld cycle. Internal flash is removed by running a drill through the section. Any excess material not removed from the exterior by the pinch-off dies is sheared off by a vertically mounted scalping unit. The piece is next inserted into a device that subjects the joint to severe bend tests. Finally, with the ends capped, liquid or air is injected into the tubing unit to check for leaks.

MACHINERY'S PROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Modified Form of Cosine Law Simplifies Calculations

F. MURRAY, Chicago, Ill.

The law of cosines:

$$\cos A = \frac{b^2 + c^2 - a^2}{2\,bc},$$

if written in the form

$$\cos A = \frac{(b + c + a)(b + c - a)}{2\,bc} - 1,$$

is better adapted to slide-rule or logarithmic calculations. Regular arithmetical calculations are also simplified, as only multiplication is required in the numerator in place of the addition and subtraction of three squares necessary in the conventional formula. The alternate form is derived as follows:

$$\cos A = \frac{b^2 + c^2 - a^2}{2\,bc}$$

add 1 to each side

$$1 + \cos A = 1 + \frac{b^2 + c^2 - a^2}{2\,bc}$$

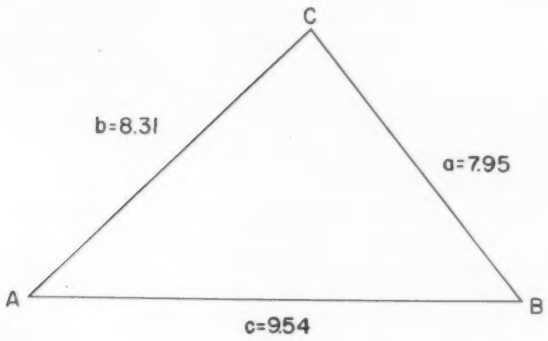
$$= \frac{b^2 + 2\,bc + c^2 - a^2}{2\,bc}$$

$$= \frac{(b + c)^2 - a^2}{2\,bc}$$

$$= \frac{(b + c + a)(b + c - a)}{2\,bc}$$

subtract 1 from each side

$$\cos A = \frac{(b + c + a)(b + c - a)}{2\,bc} - 1$$



Problem:

Find cos A, using the slide rule to make a quick check of the triangle shown in the accompanying illustration.

Solution:

By two easy additions, the factors in the numerator are $8.31 + 9.54 + 7.95 = 25.80$ and $8.31 + 9.54 - 7.95 = 9.90$.

Substituting these values in the simplified form of the law of cosines yields:

$$\cos A = \frac{25.80 \times 9.90}{2 \times 8.31 \times 9.54} - 1$$

In this case, evaluating the fraction is an elementary exercise on the slide rule which, if properly carried out, will yield 1.61, the decimal point being located by inspection. Thus:

$$\cos A = 1.61 - 1.00 = 0.61, \text{ and}$$

angle A, as read on the slide rule, is 52°25′. A closer solution, using five-place logarithms, will give an angle of 52° 20′.

Calculating $\sqrt{A^2 + B^2}$ and $\sqrt{A^2 - B^2}$ Directly on a Slide Rule

HENRY H. RYFFEL, Mathematics Editor

Problem:

How can the square root of the sum or difference of two squares be calculated directly on the slide rule without going through the usual intermediate steps of squaring *A* and *B*, adding or subtracting them, and finally extracting the root?

This question has been asked by a number of readers having log log duplex and polyphase duplex slide rules, as well as those possessing only the simple Mannheim rule.

An easy method that can be used with duplex type slide rules and in somewhat modified form with the simpler types is as follows:

Solution:

To find $\sqrt{3^2 + 4^2} = 5$,

align the index of the sine scale over 4 (the larger number) on the *D* scale. Next, set the hairline over 3 on the *D* scale and read on the *tangent* scale the angle 36.9°. Finally, without moving the slide, bring the angle 36.9° on the *sine* scale under the hairline and read 5 under the right-hand index.

Obtaining the square root of the difference of two squares is even easier.

To find $\sqrt{5^2 - 4^2} = 3$,

set the index of the sine scale over 5 on the *D* scale. Then position the hairline over 4 on the *D* scale and read on the sine scale the angle 53.1°. Without moving the *sine* scale, set the slide to the same angle on the *cosine* scale (53.1°) and read 3 on the *D* scale. In cases where the cosine of the angle is off the *D* scale, exchange the index of the sine scale with the opposite hand index.

New Plant Symbolizes Golden Anniversary

Celebrating fifty years of growth and progress, the Fafnir Bearing Co. has placed in full operation a recently completed plant representing an investment in excess of $6,000,000. The building—which encompasses 460,000 square feet—is located in Newington, Conn., not far from the company's main plants in New Britain.

Newington is a production man's plant. It was designed and built with four basic objectives in mind. First, to provide the best possible environment—in both structure and layout—for the manufacture of a wide variety of bearing types and sizes for diverse applications; at the same time giving high priority to precision and quality control. Second, to provide maximum productivity potential, with all that this implies in terms of goods and services for both product and personnel, and still assure maximum flexibility for a business in which product and production emphasis are constantly changing. Third, to hold manufacturing and overhead costs to a minimum consistent with sound business and engineering practices. And fourth, to be a business, civic, and esthetic asset of the community.

The project was planned to encompass several separate, but ultimately related, sections. One section of the building, covering 220,000 square feet, was completed first. It houses all primary manufacturing steps in making inner and outer bearing rings—steel receiving and weighing, storage, machining, and heat-treating. This portion of the plant was operated as a complete entity and its output was integrated with the finished bearing operations being performed in New Britain.

When the final 240,000-square-foot section was completed, it gradually received much of the output of the first section. The new addition houses ring- and race-grinding operations, polishing, honing, notching of inner and outer rings, inspection of all vital production stages, assembly, final inspection, storage, and will house shipping.

Finish-ground inner and outer rings are being assembled with balls at Fafnir's recently completed Newington plant. In subsequent operations, retainers and seals will be added. This department has controlled atmosphere, and air is filtered for maximum cleanliness.

NEW DEVELOPMENTS IN

Machine tools, unit mechanisms, machine parts, and

Bullard Type "M" General-Purpose Mult-Au-Matic

Since the introduction of its Mult-Au-Matic multiple-spindle lathe forty-seven years ago, the Bullard Co., Bridgeport, Conn., has expanded this series of machines numerous times to meet advanced metalworking requirements. The most recent addition to this series of Mult-Au-Matics is the new Type "M," developed to meet industry's demands for a general-purpose machine based on the Mult-Au-Matic principle and which would be available at a price lower than equivalent equipment now available. This low-cost machine contains many new features and is primarily engineered to take advantage of high spindle speeds, a wide range of feeds, and modern cutting tools.

One advantage of the new machine is its space-saving characteristics. It is only 90 inches in diameter and stands 142 3/8 inches high above the floor. It varies in weight from 25,500 to 34,000 pounds, depending upon the number of spindles. The machine is available in six-, eight-, or twelve-spindle sizes. It is powered by a motor operating at 1800 rpm which is furnished in sizes up to a maximum of 60 hp. The size of the motor will depend upon the work to be handled.

The column, firmly secured to the base, has on its lower end a long adequately lubricated taper bearing for the carrier as well as the ball thrust bearing. Secured to the top of the column is the base upon which the feed units and driving mechanisms are mounted. Tool-slides are assembled on hardened and ground bearing ways at the sides of the column. This construction, together with the accurate indexing mechanism, results in the complete coordination of spindles, feeds, and tool-carrying

Spindles are mounted on three precision antifriction bearings to insure proper alignment and permit the use of speeds up to 400 rpm on six- and eight-spindle machines and 750 rpm on twelve-spindle machines. A conical-shaped chip-and-coolant guard encloses the spindles, prevents chips from piling up behind the work-spindles, and directs both chips and coolant to the outer chip trough for easy removal. The heavy-duty, hydraulically actuated clutch-and-brake mechanism has a constant follow-up feature

Type M Mult-Au-Matic announced by the Bullard Co.

Edited by Freeman C. Duston

SHOP EQUIPMENT

material-handling appliances recently introduced

which automatically compensates for wear.

Proper lubrication is assured at all times by a newly designed lubrication filter system.

Widely variable and independent spindle speeds, through the use of change-gears, can be obtained at each work station. Feed rates can also be varied at each station to suit machining requirements. This type of feed is based on a cam-feed principle. It is equipped with a safety device for protection against overloads and has antifriction bearings.

Numerous types of heads, both standard and auxiliary, are available. Among these is the plain vertical head which has an 8-inch vertical movement. There is a plain compound head which has a single tool-slide mounted on the saddle. The standard universal head has a single tool-slide mounted on a saddle which functions vertically, horizontally, or in any angular direction. This head may be swiveled up to 90 degrees either side of the work axis.

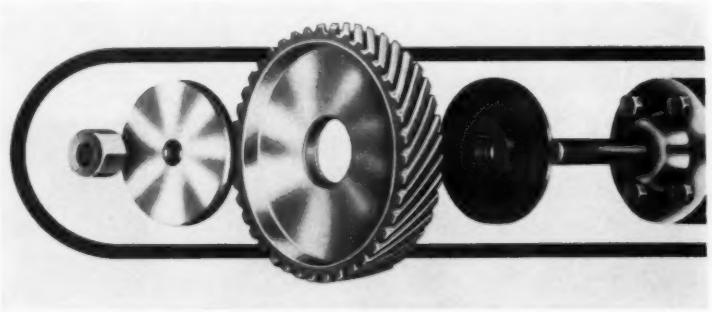
Two tool-slides are mounted on the saddle of the standard double-purpose head. One of these operates vertically only. The other, on the right-hand side, moves simultaneously in a horizontal direction. It has a total 8-inch stroke with a maximum 3-inch vertical slide movement. Its horizontal slide movement is in standard ratios of 1 to 1, 4 to 3, 2 to 1, and 3 to 1. Other ratios can be supplied. The direction of feed or ratio of the horizontal slide can be readily adjusted.

A standard double-purpose head is available for application on twin-spindle machines only. Two designs can be furnished—one with a left-hand vertical slide and right-hand horizontal slide, while the other has a right-hand vertical slide and a left-hand horizontal slide. The slides function simultaneously according to a predetermined gear ratio.

Drilling, tapping, and threading operations are performed in comparable time to other operations on the machine through the use of Bullard drill heads or threading and tapping heads. The single-spindle drill head is easily mounted on the slide, while the multiple-spindle drill head is mounted directly on the saddle.

Circle 573 on Readers' Service Card

"Cosmo-Contact" Wheels with Self-Aligning Flanges



Contact wheel and self-aligning flanges for abrasive-belt finishing

Cosmo-Wheels, Inc., Chicago, Ill., has announced its new "Cosmo-Contact" wheels with self-aligning flanges for use in the finishing and grinding field. The contact wheels of this equipment are specially selected to obtain the maximum advantages from the use of abrasive belts. The hardness of the material, the finish desired, and stock removal rates are all considered in the wheel selection. Cosmo-Contact wheels are available in a wide range of sizes to suit each particular job.

The new shaft flanges are designed for use with present equipment and can reduce grinding and finishing costs because they reduce vibration and are economically priced. These flanges, shown in the illustration, are ruggedly constructed of 1/8-inch steel discs, faced with a rubber cushion that fits up snug to any worn or scored shaft. Centrifugal force will give perfect alignment and balanced, vibration-free operation. They eliminate high and low spot problems, resulting in a more uniform and finer finish for the product.

The smooth operation of this grinding and finishing process is said to save wear and tear on machinery, and reduce fatigue.

Circle 574 on Readers' Service Card

Automated System for Hardening Rocker Arms

The Induction Heating Corporation, Brooklyn, N. Y., has designed and built fully automated equipment for leading car and truck manufacturers which will harden rocker arms at the rate of 1800 an hour. The company's Ther-Monic Model 2500 generator employed in this equipment is a standard unit. However, a variety of adjustments permit its direct use for this job and for many others around the shop or plant. The generator is able to develop full power output and maintain it under continuous operation.

Immediately in front of the generator (see illustration), may be seen the conveyor type work station. This traveling conveyor is hand loaded and automatically unloaded at the rate of one part every two seconds. The heating and quenching cycles are completely automatic, so that with automatic unloading of the parts the operator only has to load parts in the fixture of the conveyor.

The soft end of the rocker arm is first heated to the proper temperature for hardening, then passed into a quench zone where it is automatically oil-quenched. From this point it proceeds to the unloading zone. To maintain proper temperature of the oil-quenching medium, a cabinet is installed under the conveyor that contains a circulating oil-pump, a storage tank for the quenching oil, a heater system to bring the oil to proper operating and quenching temperature, and a water-cooled oil cooler so that the oil may be cooled when necessary.

After the unit is in operation, the quenching of the hot workpieces gradually raises the temperature. A sensing device then cuts off the heating system and starts cooling the oil. In this way the quench oil is maintained at the set or predetermined temperature. The conveyor system is powered with a variable-speed drive, so that the speed at which the conveyor travels can be varied to suit the particular application.

Circle 575 on Readers' Service Card

Bendix Control Choice of Tape Formats

The new DynaPath-20 series contouring control system, manufactured by the Industrial Controls Section of Bendix Corporation, Detroit, Mich., has been designed to utilize either binary-coded-decimal (B.C.D.) or straight binary punched-tape formats (illustrated in Fig. 2). The straight binary option has been provided to permit compatible programming with previous Bendix systems. This format is ideal for computer-prepared tapes, as binary numbers are the language of the computer.

A word address, binary-coded decimal format is also being offered on the DynaPath-20 controls. The B.C.D. format is used extensively in point-to-point control systems and is currently being adopted as a standard by the Electronic Industries Association. An experienced programmer can easily read a B.C.D. tape.

With the introduction of the B.C.D. format, it is possible to make, modify, reproduce, and verify tapes on a Flexowriter. Thus, control tapes for simple contouring operations can be pre-

Equipment designed and built by Induction Heating Corporation for hardening automotive engine rocker arms and other similar parts

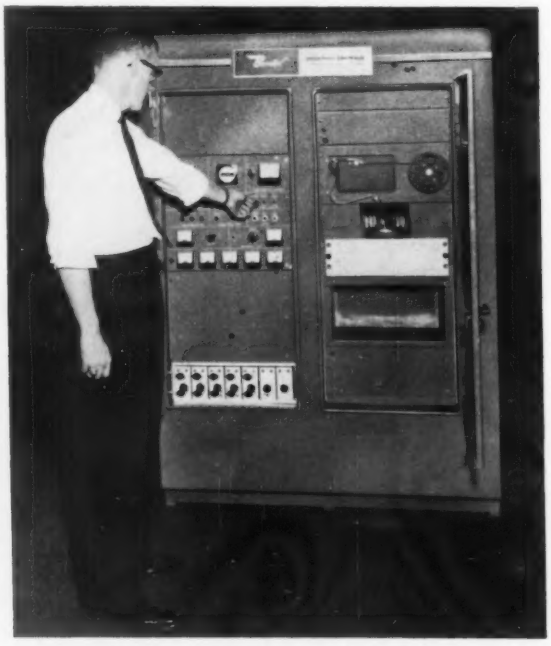


Fig. 1. Checking out a new DynaPath-23 (three-axis) numerical contouring control unit shown with binary-coded-decimal punched-tape reader

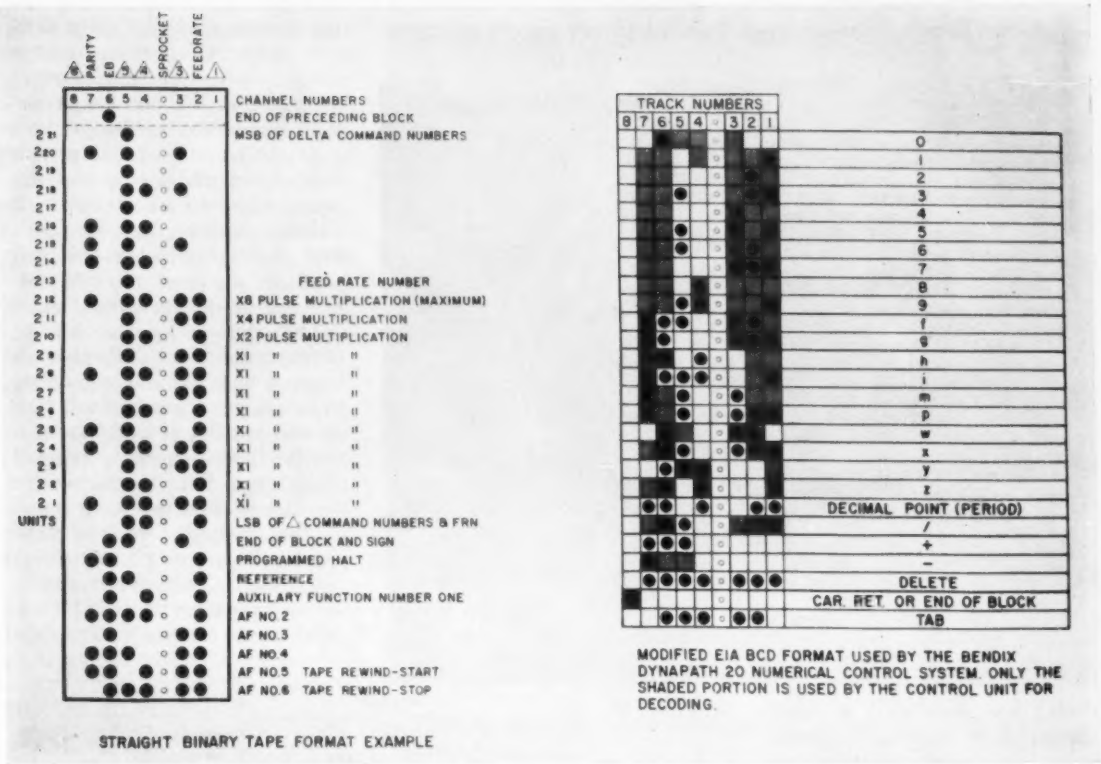


Fig. 2. Two punched-tape formats available with Bendix DynaPath-20 series contouring systems

pared without the use of a computer. Computer routines are available with output binary-coded-decimal as well as straight binary tapes for processing more complex parts.

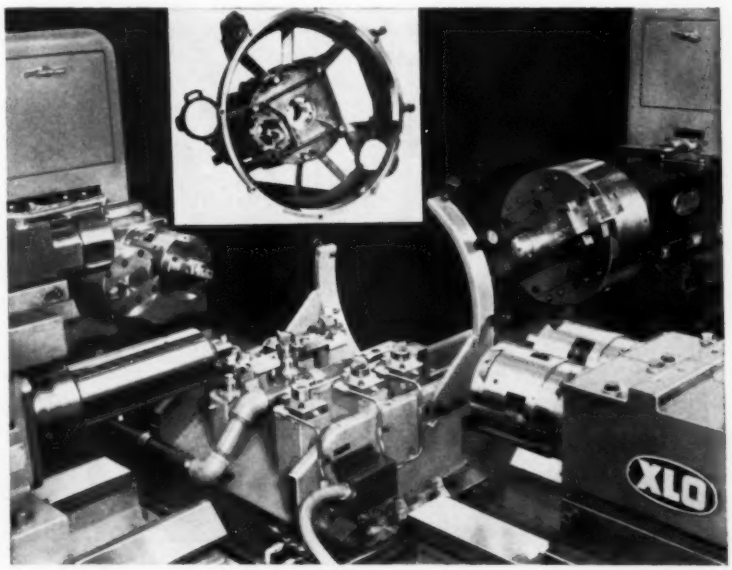
Circle 576 on Readers' Service Card

Four-Way Precision Boring Machine for Processing Aluminum Crankcases

The fixturing on a standard four-way precision boring machine recently made by the Ex-Cell-O Corporation, Detroit, Michigan, will accept two types of die-cast aluminum crankcases for air-cooled engines. The machining operation is initiated by push button, whereupon the front and rear slides advance, finish-bore and chamfer the opposing cylinder holes, and finish face the cylinder mounting pads.

Crankshaft-bearing diameters are bored from the left side, holding a tolerance of 0.0003 inch. Spindles mounted on the right slide finish-bore, face, and chamfer the large-diameter housing. The tolerance on this 15-inch diameter member, which needs dampening because of its fragility, is held to within 0.003 inch. At the completion of the working strokes all slides retract, the part is unclamped, and the locating pins are withdrawn automatically.

Circle 577 on Readers' Service Card



Ex-Cell-O four-way machine for processing die-cast aluminum crankcases like the one shown in the insert

Gear-Tooth Spacing and Runout Checking System

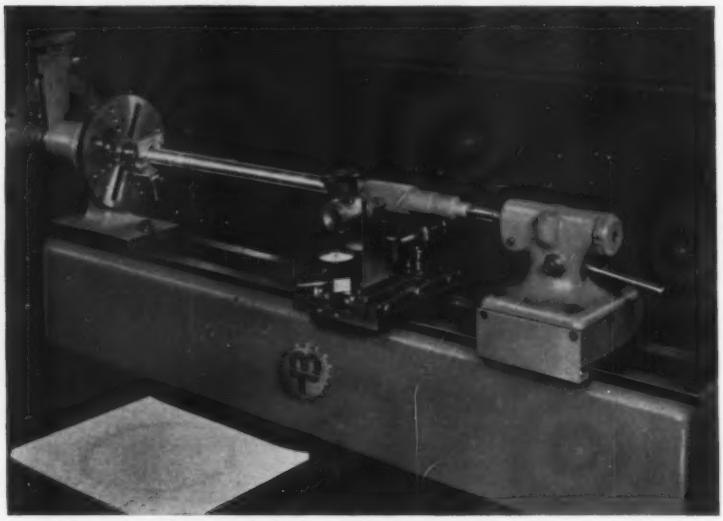


Fig. 1. Heart of the new Michigan tooth-space error-checking system is this checker Model 1132 in which the toothed part is positively indexed

The Michigan Tool Co., Detroit, Mich., has developed a simple spacing-check system that determines both runout and true spacing errors. This system also graphically helps identify causes of tooth-spacing errors in straight or helical gears and splines. A very short training session in the technique of the system enables the average machine operator to check toothed parts and accurately determine tooth-spacing errors.

The basic system comprises a checker of new design, Fig. 1, translucent chart, Fig. 2, and a light table. Since the system is designed for either production checking or laboratory use, mechanical units are rugged and adjustments can be made quickly and easily. The new Michigan Model 1132 tooth-spacing and concentricity checker (Fig. 1) used with this system comprises a bed with ways, an adjustable pointer carriage and slide, two dial indicators, and a pair of centers. The standard unit (larger checkers are available) will accept shafts up to 36 inches long with an outside diameter of 5 inches, having a wide range of pitches. This unit features a quick-acting adjustable tailstock and overtravel protection for both indicators.

The work-piece is positively indexed through use of an index-plate—several of which, for different numbers of teeth (odd or even), can be simultaneously mounted on the checker. A rack type pointer tip pivots so that it contacts both flanks of a tooth near the pitch line at the time measurements are taken. The pointer unit can be swiveled so that the tip matches the helix angle of the work-piece. Pointer tips can be quickly interchanged.

The operator loads a shaft between centers on the checker and scans it with the lower indicator to locate two opposite teeth (with an odd number of teeth, the most nearly opposite pair is selected) which give about the same reading. One of these two teeth is used as the starting point. In other words, the starting tooth should be on the mean of any runout.

The operator then slides the pointer in to contact the first tooth

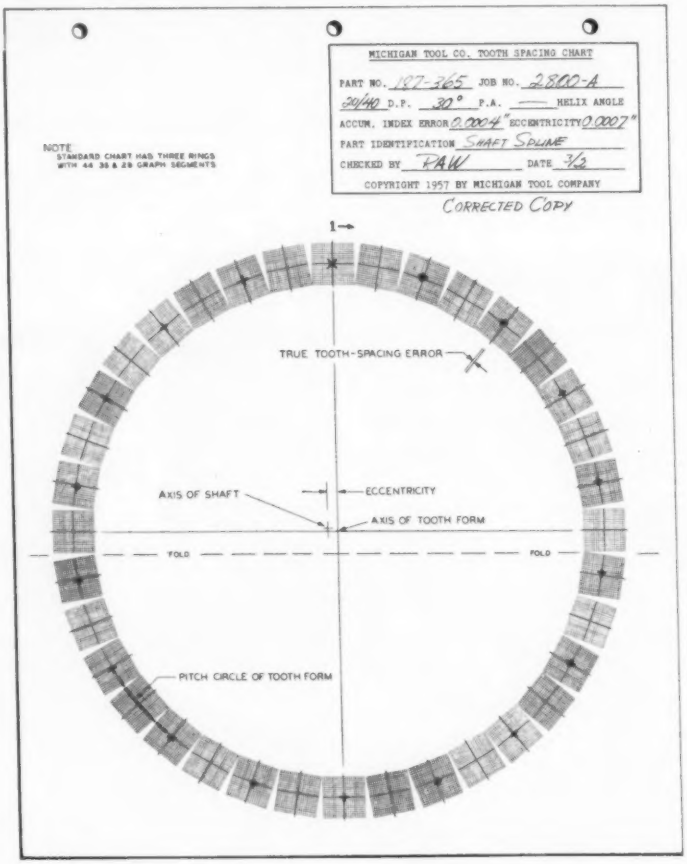


Fig. 2. Readings from checker, Fig. 1, are transferred to this translucent chart for mechanically separating eccentricity error from total error to show true tooth-spacing and eccentricity errors

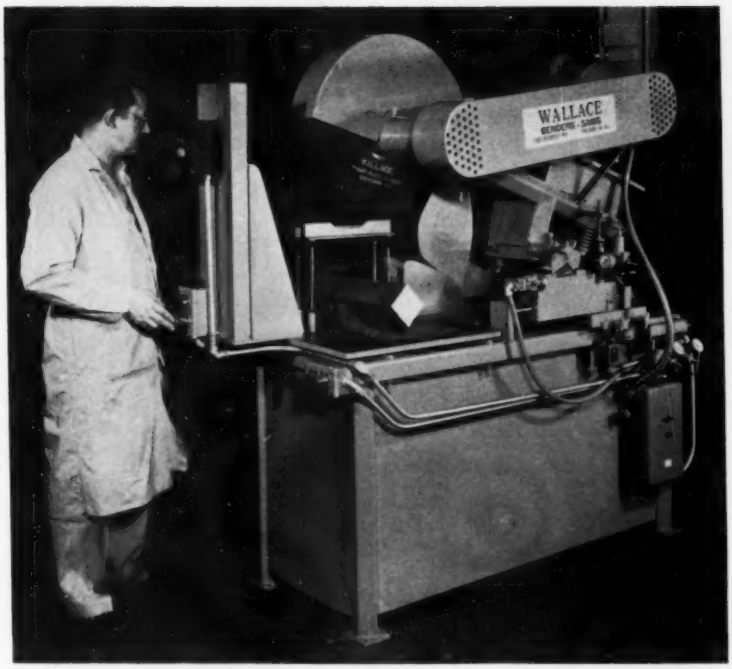
and zeros both indicators. He records a small "x" at the origin of the graph segment, Fig. 2, that represents the first tooth. Of the three rings on the standard chart, the one that will give the most symmetrical pattern is used. He then withdraws the slide, indexes the shaft, and moves the slide forward again. After reading both indicators, he marks a small plus sign on the graph segment for the second tooth. The radial bar of the plus sign shows the indicator reading (high or low) that measures the amount of pivot of the tip. The cross-bar of the plus sign shows the indicator reading (high or low) representing the slide position. This process is repeated for each tooth.

When the chart has been completed, there is an "x" in the first-tooth graph segment on the chart and a plus sign in each of the graph segments representing the rest of the teeth. The plus-sign pattern graphically describes the pitch circle of the gear or spline, but if a run-out condition exists, its center is not on the center of the chart and that part of the total error introduced by eccentricity cannot be visually separattd from the true tooth-spacing error.

Use of a blank chart and a light table "mechanizes" separation of these errors. The blank chart is placed over the original chart in such a way that the points of origin of the graph segments representing the first tooth on both charts coincide. Then, the blank chart is pivoted about this point until the centers of the graph segments on the blank chart which represent the pitch circle of the gear without runout coincide with the plus-sign pattern. All of the plus signs for each of the teeth are traced onto the blank chart. The location of the center of the original chart is also marked on the copy.

Analysis of the gear or spline errors now is a simple matter of looking at the chart tracing. The distance between the two chart centers indicates the amount of eccentricity, or the distance between the axis of the spline or gear and the axis of its shaft. The distance of the transferred plus sign from the center of its graph segment shows the true tooth-spacing error for each tooth, since eccentricity errors have been mechanically separated on the copied chart. Study of the chart will show what troubles, if any, exist and where corrective action may be necessary. The chart profile shows how the tools are working and indicates if machine centers are causing excessive runout.

Circle 578 on Readers' Service Card



Wallace cutting machine showing operator with his hand on control button

Cutter with Power Feed

The Series 1510 cutting machine with power feed and power oscillation shown in the illustration is the latest in a series of cutting equipment made by Wallace Supplies Mfg. Co., Chicago, Ill. A similar "Cutting-Unit" with chain safety curtain and remote control has been built for the testing laboratory of one of the world's largest abrasive-wheel manufacturers. With this unit ample power (25 hp) is available for testing wheels up to 26 inches in diameter. The machine can be used either as a straight chop stroke unit or it can be set to oscillate from 1 to 100, or more, strokes per minute. The stroke length can be varied from 1/2 to 6 inches.

The commercial applications for such a machine are many and varied. Solid rounds up to 6 inches in diameter (in most types of steel alloys) can be cut at the rate of about two to three seconds per square inch. With proper work-holding fixtures, channels up to the 10-inch size are easily cut. The quality of the cut surface is said to be exceptional. In terms of micro-inch finish, values as low as 32 to 64 are easily obtained.

These units are available with 18-, 20- and 26-inch wheels. A similar machine series for wet cutting covers the same range of wheel sizes plus a 34-inch diameter wheel. Remote-control hand push buttons are not standard equipment, but can be supplied in special cases to permit laboratory men to control the unit from a distance while developing new, and therefore untried or unproved, cutoff wheels. The safety chain curtain available for laboratory testing work is not, of course, needed for use with standard abrasive cutoff wheels used for regular production work.

Circle 579 on Readers' Service Card

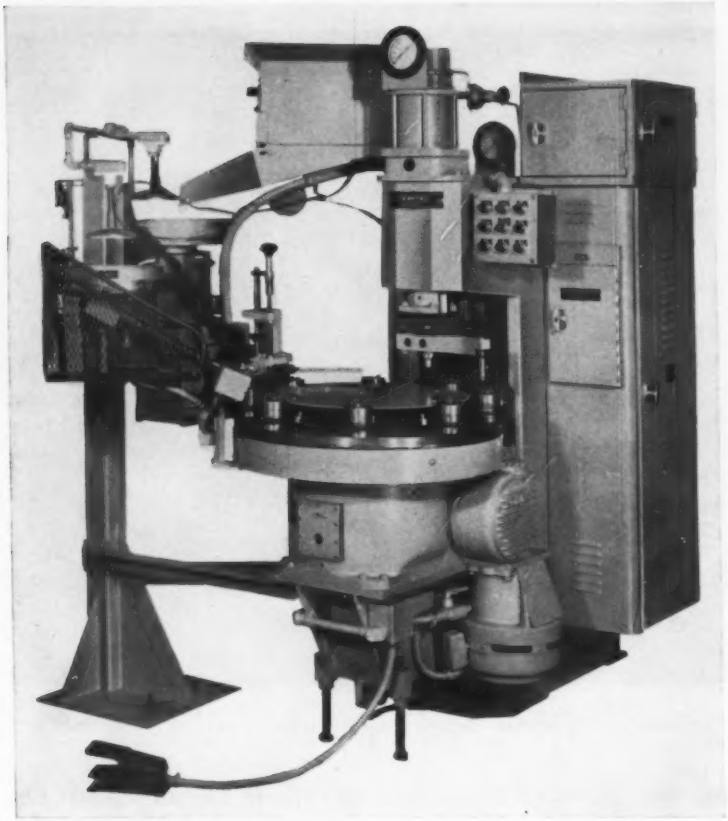


Fig. 1. Federal dial-feed machine for welding of power transistors

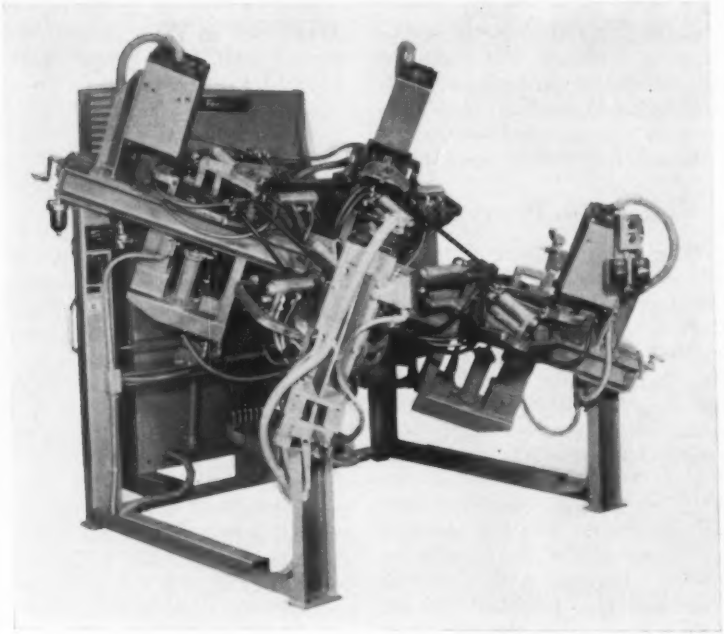


Fig. 2. Multiple-gun type projection welder for card-table fabrication

Federal Develops New Welding Equipment

Recently announced welding equipment developed by the Federal Machine & Welder Co., Warren, Ohio, includes the press type air and toggle motor-driven machine shown in Fig. 1. This machine is arranged with an eight-station dial-feed unit, complete with hopper feeds for automatic welding of the ring projection of the dome to base of transistor. It is motor-driven toggle-operated for slide travel with pressure developed through an air-cushion cylinder used as a backup member. The toggle-linkage operation gives the upper weld head a slow-approach characteristic near the bottom of its stroke. This tends to prevent the crushing of the ring projection before welding, as would be likely to occur with a direct air-operated welding head.

Each of the eight lower die units and also the upper die unit are water-cooled and have replaceable copper-alloy die inserts. An automatic ejector is provided to eject the welded part from the die. The welding transformer is arranged with eight steps of heat regulation plus a series-parallel tap switch to give a total of sixteen transformer tap settings. The drive mechanism consists of an electric motor operating an electric clutch and gear-box. The necessary air, water, and electrical accessories are provided as required for the proper automatic operation of the machine. Production is at the rate of 2500 indexes per hour.

Another new Federal development is the multiple-gun inclined projection welder, Fig. 2. This machine projection-welds hinge brackets and leg assemblies to the top rim of card-table frames. It consists of an inclined frame mounting four dual welding-gun units—one for each of the four hinge bracket and leg assemblies—together with the necessary transformer, clamp, locators, and gun and transformer mounting bracket at each corner. The machine is made adjustable for various card-table sizes. Four package type transformers furnish the welding

power. All necessary air, water, and electrical accessories, complete with piping, wiring, etc., are provided for the proper automatic operation of the unit. Production is 450 assemblies per hour.

Circle 580 on Readers' Service Card

Versatile Gear-Tooth Deburring Machine

The Davis & Thompson Co., Milwaukee, Wis., has just announced its latest development in the field of gear deburring. Through the use of double arms, both sides of gear teeth are deburred simultaneously by this machine, designated the Model DB-60, which will handle gears from 8 to 60 inches in diameter and with face widths up to 28 inches. A 1/2-hp variable-speed drive rotates the work, an electronic control providing a speed ratio of 25 to 1. Settings can be preselected.

Protractors and graduated scales are provided to facilitate accurate setups. The guards over the grinding wheels act as the intake for the dust collector. Spur, helical, worm, hypoid, bevel, spiral bevel, and shaft gears and sprockets of steel, cast iron, or bronze can readily be deburred. This machine differs from prior models in that the work is placed in a horizontal position. There is no top housing or superstructure to interfere with the handling of heavy components.

Circle 581 on Readers' Service Card

High-Production Thread- and Form-Rolling Machine

Higher production rates have been made possible with the Model A22 three-cylindrical die thread- and form-rolling machine built by the Reed Rolled Thread Die Co., Holden, Mass. The new high-speed oscillating head, now available with the standard A22 machine, is designed for production rates of up to sixty pieces per minute.

For many years the Model A22 machine has met the requirements of job-shop work for manual operation of general-purpose threading at production rates of up to approximately twenty-six pieces per minute. Higher production rates have been possible on these machines through the use of semi-automatic or fully automatic work-handling equipment, and they will still be available to meet the continuing demand for them.

The new high-speed head, designed for production rates of approximately 50 to 100 per cent higher than obtained by previous automatic setups, will be available for use where high-speed automatic operation is required. These higher production rates have been achieved through the use of aluminum in the cam-actuated oscillating head. This represents approximately 40 per cent less weight in the complete head assembly. The cam-lever return unit has been redesigned to accommodate the higher rate of oscillation, including changes in the spring assembly and housing. This heavy-duty cam-lever unit is designed to maintain contact of the cam-roll on the cam at high speeds.

The new cam contour has been especially developed for smooth operation of the head at the higher rates of 50 to 60 cycles per minute. The cam provides positive action and control for optimum rolling conditions based on preferred penetration and work revolution rates.

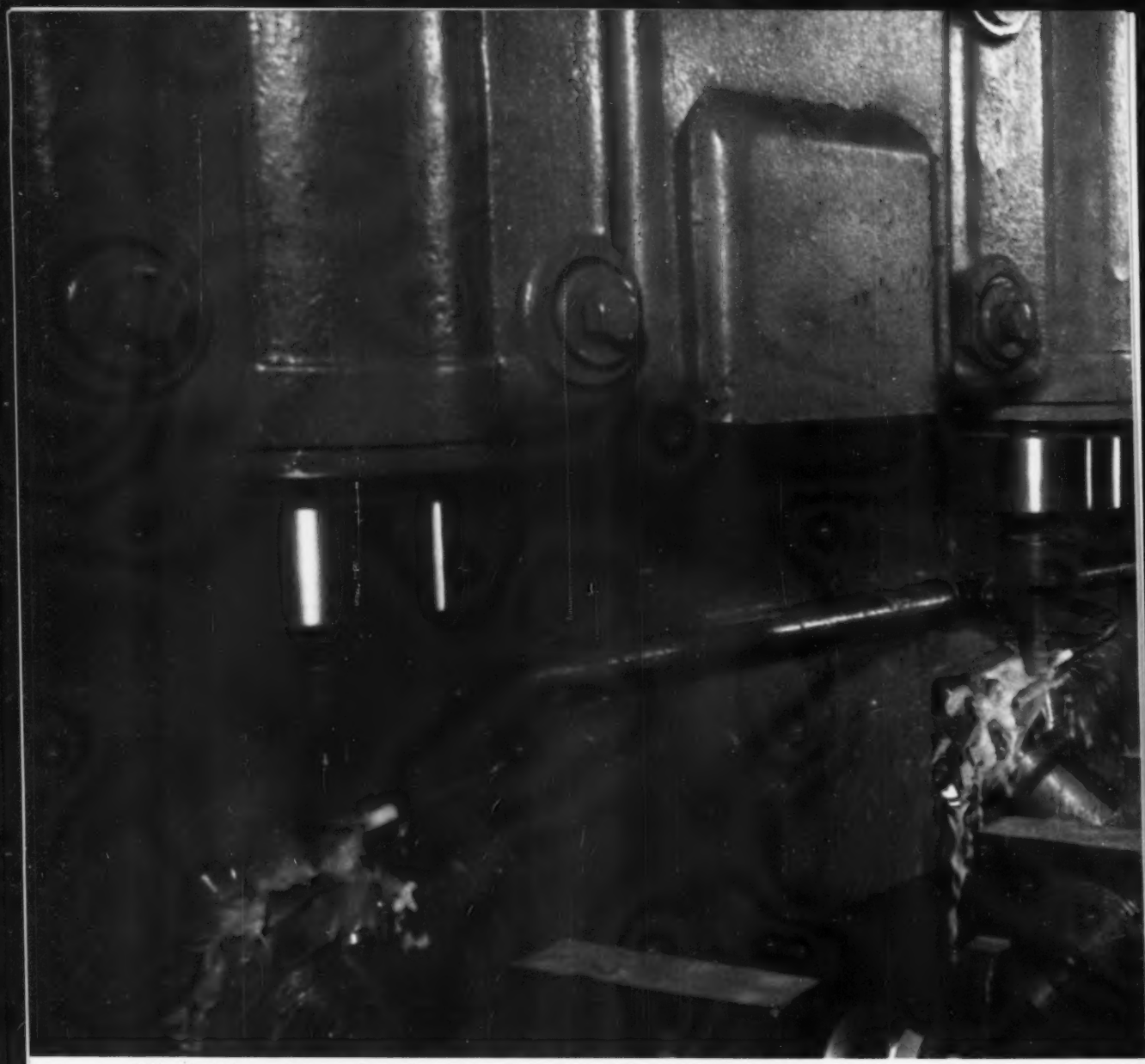
The Model A22 machine is available with the high-speed head at no change in price. High-speed work-handling equipment for a wide variety of parts is available for operation at the higher production rates. The actual production rates depend not only on the material and size of thread or form to be rolled, but also on the shape and weight of work which may determine the handling time.

The Reed three-die principle provides self-centering of the work between the three dies, eliminating the need for separate equipment to position or support the work relative to the axis of rolling. The work rotates about its own axis, inherently providing excellent control of roundness. Hollow or thin-walled work can be successfully rolled, using the three-cylindrical die principle.

Circle 582 on Readers' Service Card

Davis & Thompson gear-tooth deburring machine

Reed high-production thread- and form-rolling machine



Milling teeth in rock bits on a 4-spindle machine. The coolant: Gulfcut Heavy Duty Soluble Oil.

Change to Gulfcut® Heavy Duty Soluble cuts maintenance costs . . .

Varel Manufacturing Company has supplied rotary drilling tools to the oil industry for many years. Recently, this Dallas, Texas, firm had to battle a severe rust problem—in gearboxes and on finished parts.

The company turned to Gulf for help. And got it. Gulf Engineers recommended Gulfcut Heavy Duty Soluble Oil in place of the chemical coolant then in use. Result: no more rust!

"By eliminating rust, improving lubrication and cooling," says Malcolm Thomas, Production Manager, "we brought maintenance costs down to earth. Before the switch, our gearboxes got so rust-infested that we had to down machines for a whole day to clean them. But that's no longer a problem—and neither is paint peeling.

"Here at Varel, we use a mixture of 30-40 parts water to one part oil. And we've found that Gulfcut Heavy Duty Soluble Oil meets every one of our machining requirements."

If you're faced with a stubborn machining problem,

Oil eliminates rust and paint peeling, GULF MAKES THINGS RUN BETTER!

give us the opportunity to show you how Gulf makes things run better! Call a Gulf Sales Engineer at your nearest Gulf Office. Or write for Gulfcut literature.

GULF

GULF OIL CORPORATION
Dept. DM, Gulf Building
Houston 2, Texas

R. J. Blanton, left, Executive Vice-President & General Plant Manager of Varel Manufacturing Company, and Grover Garrison, Gulf Sales Engineer. In the foreground, a 12¼" VHI rock bit.

SP-10049

Ther-Monic Heat-Treating Equipment

The Induction Heating Corporation, Brooklyn, N. Y., has brought out a Ther-Monic unit, Fig. 1, which anneals auto brackets automatically in four seconds. Four uniform sections of two auto-chassis plates are completed simultaneously on this equipment by unskilled labor. The unit not only heats the four parts uniformly, but handles all the parts simultaneously and automatically as well. It consists of special tooling installed in a Ther-Monic single-position, all-steel heavy-gage modular table. This unit contains all of the control circuitry and a Ther-Monic variable-ratio output transformer which reduces work-coils to safe, low-voltage operation. The coils are connected to a ground secondary, which assures maximum safety to the operator and the coils. Other features of the table are the water-pressure switch for protection of the coils, and flat type work leads for quick coil changing.

The work-table consists of an automatic hopper, indexing conveyor, and the work-coil. Plates are stacked about 20 inches high in the hopper on the right side of the work-table. The indexing conveyor picks one plate at a time from the bottom of the stack and moves it into the four heating positions of the work-coil. At the end of each heating cycle the plate is automatically removed and restacked at the base of the table while another plate is moved into the heating position.

Enclosure collars used as bearing retainers for railroad-car axles are quickly hardened, drawn, and quenched by a new technique and accessory equipment, Fig. 2, also designed and manufactured by Induction Heating Corporation. The single machine setup will handle seven different sizes of these railroad-axle end caps, ranging from 7 to 10 inches in inside diameter. The hardness pattern required on the pearlitic malleable-iron collars necessitates hardening one end around the periphery only 1/16 inch from the face down, and 3/16 inch across the face itself.

With this simple setup, parts are processed in the following manner: first, the operator places the proper adapter on the rotating spindle used for the desired part; secondly, he selects one of the Ther-Monic patented insert coils and simply fastens it to the master coil with the six screws provided; and thirdly, he sets the Multiflex timer for the heating and quenching cycle. The average range for the seven sizes is: heating time, thirty to forty-five seconds; and quenching time, one and five-tenths seconds. (Note the extremely short duration of the quenching time.) The reserve heat left in the part draws the part down from 60 to the 45 to 50 Rockwell C scale hardness needed.

With this equipment, the operator simply places parts on the spindle and depresses the "start" cycle button, after which all operations are completely automatic. The fixturing and table comprise a standard Ther-Monic single-position quench type work station consisting of a welded steel frame, ebony-asbestos front panel, multiple-circuit timer, and necessary quench flow and control valves, complete with a motor-driven rotating spindle and spindle adapters with quenches. The generator itself is a Model 2500 with 25-kw output and is complete with oscillator and rectifier voltage regulators, electronic keying, and water-to-water heat exchanger installed within the generator itself.

Circle 583 on Readers' Service Card

Fig. 1. Ther-Monic unit designed and equipped for automatic annealing of auto brackets

Fig. 2. Unit developed for hardening, drawing, and quenching railroad-car axle collars

COLD-DRAWN SEAMLESS MECHANICAL TUBING—1

Examples in Calculating Nominal Tube Size Required to Machine a Given Part

A round seamless tube section has three dimensions, all of which may vary independently. These are the outside diameter (O.D.), the inside diameter (I.D.), and the wall thickness.

1. *Nominal*, as applied to any of these dimensions, refers to the theoretical or stated value of that dimension. These are dimensions ordinarily specified by the customer.
2. *Maximum* and *minimum* refer to the greatest and the least values of any dimension constituting the agreed upon limits within which all such dimensions must fall.

In calculating the nominal dimensions of a tube required to clean up to finished size, there are three considerations to be made*:

1. The outside diameter (O.D.) may vary plus and/or minus, depending on size, from theoretical size within commercial tolerances.
2. The inside diameter (I.D.) may vary plus and/or minus from theoretical size within commercial tolerances.

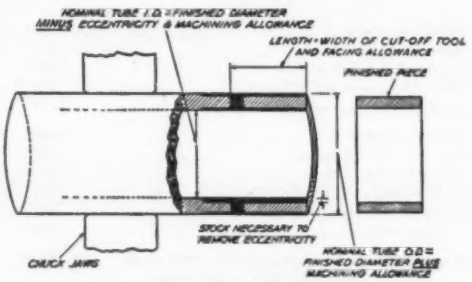


Fig. 1 Chucking to Outside Diameter

3. The inside circle may not be precisely concentric with the outside circle, resulting in a variation in wall thickness within commercial tolerances. Eccentricity does not affect the outside diameter or inside diameter sectional area, weight per foot or tensile strength of the tube. It has very little effect on resistance to bending and torsional stresses, but it must be allowed for to figure sufficient stock for finishing.

Thus, in addition to the fact that the outside diameter and inside diameter may vary from theoretical size, the inside circle may not be precisely concentric with the outside circle. If this is the case, the walls will not be perfectly uniform in thickness, being thinner on one side of the tube and thicker on the opposite side. The diagrams herewith will show how eccentricity and its corresponding variation in wall thickness must be allowed for. Note that the method for chucking is important because it determines whether eccentricity in the tube will be reflected in the outside diameter or inside diameter.

Calculation of the nominal tube size for machining is simplified by ignoring the maximum permissible wall thickness and considering only the minimum thickness resulting from the permissible tolerances. It is this minimum thickness that determines how much provision should be made to allow cleaning up the tube in machining. On the reverse side of this chart are shown two examples of the calculation of a nominal size tube required to finish to a specified size. These examples are shown to illustrate the method of calculation for both methods of chucking.

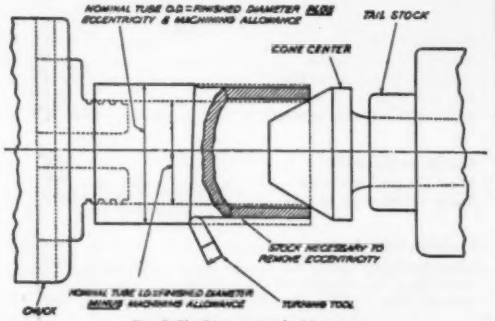


Fig. 2 Chucking to Inside Diameter

*Special Note: Tolerances are applicable only to two dimensions (length excepted). Thus, if O.D. and wall are specified, the theoretical I.D. may not conform to published tolerances. If O.D. and I.D. are specified, the wall may not conform to published tolerances except that the mean or average wall (taking into account the permissible O.D. and I.D. tolerances) will not vary more than indicated under "Wall tolerances." Warehouse stocks of seamless mechanical tubing are invariably manufactured to O.D. and wall tolerances. For a table of standard tolerances, see Frasse Data File, Sec. B, No. 1.

Courtesy of Peter Frasse & Co., Inc.

COLD-DRAWN SEAMLESS MECHANICAL TUBING—2

Method of Calculating Nominal Tube Size Required to Machine a Given Part

CHUCK TO O. D.

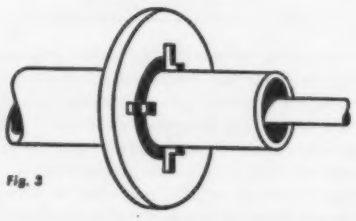


Fig. 3

Finished Machined Dimensions Required:
1.960" O.D. x 1.620" I.D. x 6" long

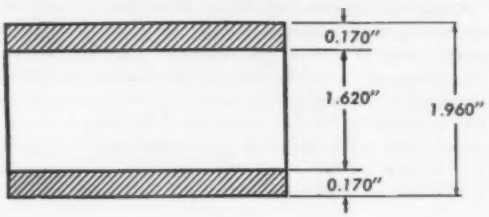


Fig. 5

Desired machined O.D.	1.960"
Plus O.D. stock allowance	.040"
Equals minimum O.D. of tube	2.000"
Plus O.D. dimensional tolerance	.010"*
Equals maximum O.D. of tube	2.010"
Desired machined I.D.	1.620"
Minus I.D. stock allowance	.040"
Equals maximum I.D. of tube	1.580"
Maximum O.D. of tube	2.010"
Minus maximum I.D. of tube	1.580"
Equals twice the minimum wall	.430"
Minimum wall	.215"
Minimum wall subject to tolerance of ± 10% equals *Which is equivalent to .239" average wall.*	.215"/.9*

Nominal size tube required for job:

2.000" $\left(\begin{matrix}+.010\\-.000\end{matrix}\right)$ O.D. x .239" (±10%) wall

(Nearest stock size.....2" O.D. x ¼" wall)

CHUCK TO I. D.

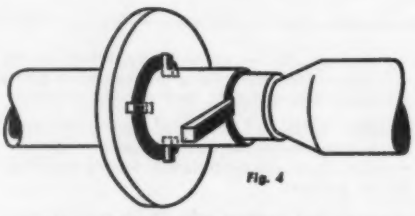


Fig. 4

Finished Machined Dimensions Required:
1.960" O.D. x 1.620" I.D. x 6" long

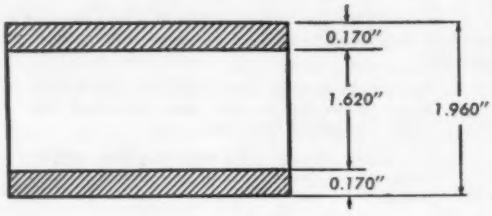


Fig. 6

Desired machined I.D.	1.620"
Minus I.D. stock allowance	.040"
Equals maximum I.D. of tube	1.580"
Minus I.D. dimensional tolerance	.010"*
Equals minimum I.D. of tube	1.570"
Desired machined O.D.	1.960"
Plus O.D. stock allowance	.040"
Theoretical tube O.D.	2.000"
Minus minimum I.D. of tube	1.570"
Equals twice the minimum wall	.430"
Minimum wall	.215"
Minimum wall subject to tolerance of ± 10% equals *Which is equivalent to .239" average wall.*	.215"/.9*
Minimum I.D. of tube	1.570"
Plus 2 times average wall	.478"
Equals minimum O.D. of tube	2.048"

Nominal size tube required for job:

2.048" $\left(\begin{matrix}+.010\\-.000\end{matrix}\right)$ O.D. x 1.580" $\left(\begin{matrix}-.010\\+.000\end{matrix}\right)$ I.D.

*Standard dimensional tolerances are shown on Frasse Data Chart Sec. B, No. 1

MACHINING ALLOWANCES

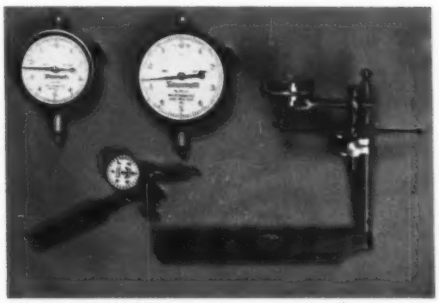
For Machined Parts Size, OD Inches	Machining Allowances on Diameter, inch OD	ID	For Machined Parts Size, OD Inches	Machining Allowances on Diameter, inch OD	ID
Less than 3/32	0.008	0.008	1½ to 3, excl.	0.040	0.040
3/32 to 3/16, excl.	0.012	0.012	3 to 5½ excl.	0.060	0.060
3/16 to ½, excl.	0.015	0.015	5½ to 8, excl.	0.080	0.080
½ to 1½, excl.	0.020	0.020			

NOTE: Machining allowances for sizes 8 inches and over are customarily negotiated between purchaser and producer.

Courtesy of Peter Frasse & Co., Inc.

PRECISION TOOLS — No. 666 Feeler Stock in new rewind-dispenser metal case, No. 667 Feeler Stock Assortment of 12" lengths, No. 167 Radius Gages.

Starrett® precision in practical packages

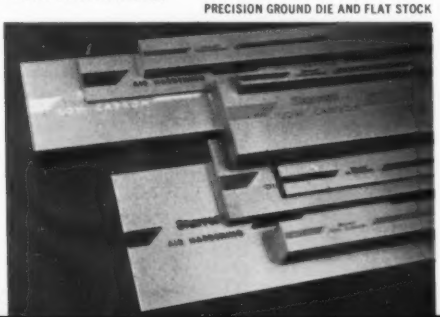


DIAL INDICATORS AND GAGES

Next to precision and reliability, convenience is the big reason shop men swear by Starrett products. For example, feeler stock is now available in 25-foot rolls in a new rewind-dispenser metal case that lets you wind out the length you need, wind back the excess for complete protection. Also 12-inch lengths or boxes of 12 pieces in a choice of 27 thicknesses from .001" to .025" — or a 108 piece assortment.

New Starrett satin finish stainless steel radius gages illustrate the way many Starrett tools are furnished — in attractive, protective cases designed for instant selection of the right tool for the job.

For more information about these and the many other fine Starrett products, call your nearby Industrial Supply Distributor or write for complete Catalog No. 27. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U.S.A.



PRECISION GROUND DIE AND FLAT STOCK

HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES

World's Greatest Toolmakers

STOP DISCARDED CUTTING OIL LOSSES!

A "Cleartex Cure" ends the cutting oil dilution problem forever...cuts per-piece production costs as much as 40%

In spite of precautions, lube oil dilutes the cutting oil in up to 70% of all automatics. This dilution can mean substantial losses in discarded oil. Worse yet—diluted cutting oil can be even more costly in terms of shortened tool life ...increased downtime...a higher percentage of rejects.

Cleartex—triple-purpose oil. In every instance a "Cleartex Cure" eliminates these losses instantly because Texaco Cleartex works in *both* the cutting *and* lubricating sumps of all your automatic screw machines. Acts as a hydraulic fluid, too. The "Cleartex Cure" can cut your per-piece production costs as much as 40%.

How a "Cleartex Cure" works. Getting the benefits of a "Cleartex Cure" is easy. Just have an experienced Texaco engineer come to your plant. He'll survey your automatic set-up . . . tell you which machines can benefit from Cleartex. Chances are, a "Cleartex Cure" can net you considerable savings.

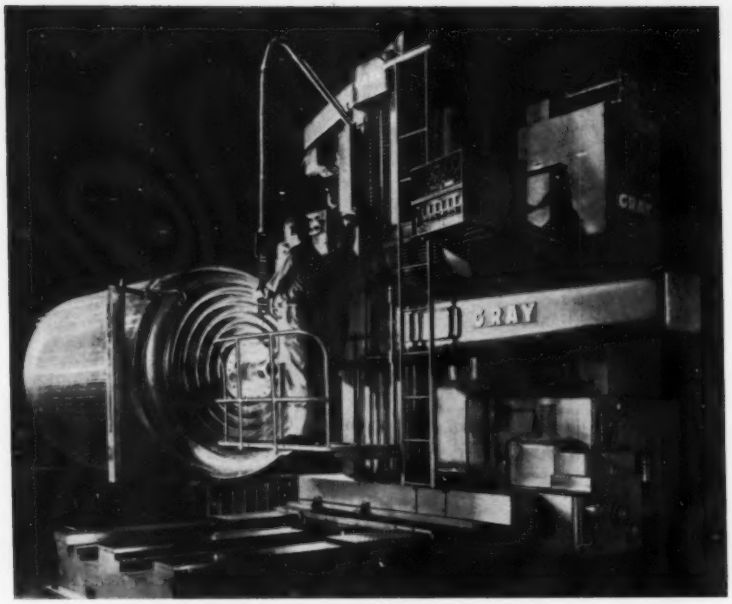
Send for free booklet. Our illustrated booklet, "Cleartex in Automatic Screw Machines" gives full details on how diluted cutting oil may be eating into your profits. To get your copy, plus a survey of your automatics, contact your nearest Texaco distributor—or write Texaco Inc., 135 East 42nd Street, New York 17, N. Y., Dept. MA-100.

Tune In: Texaco Huntley-Brinkley Report, Mon. Through Fri.-NBC-TV

TEXACO

Throughout the United States

Canada • Latin America • West Africa



Horizontal boring, drilling, and milling machine, equipped with Norden Space Setter readout numerical control, announced by the G. A. Gray Co.

Gray Boring, Drilling, and Milling Machine with Numerical Control

A new horizontal boring, drilling, and milling machine equipped with "Space Setter" readout numerical control adapted for economical handling of short-run work has been built by the G. A. Gray Co., Cincinnati, Ohio. This machine has been especially designed to eliminate costly tooling and permit faster change-over from one job to the next.

The Gray Space Setter system offers progressive steps to full tape control. The readout provides a basic and infallible counting or measuring system. Drawing dimensions can be read on the readout panel. The Space Setter system allows accuracies to within 0.001 inch and is unaffected by line voltage.

A new low-mounted Televersal attachment results in constant rigidity and permits heavier feeds and faster cuts. The three-spindle work-head swivels and can be locked at any alternative angular position for multiple setup jobs. A self-contained jib crane with 2000-pound lifting capacity makes the operator independent of other shop facilities when changing tools. The unit also features a power-operated draw-bar, and electric "woodpecker" multiple-ton column and head that may be push-button set to within accuracy limits of 0.00025 inch.

Circle 584 on Readers' Service Card

Bryant Double-End Internal Grinder

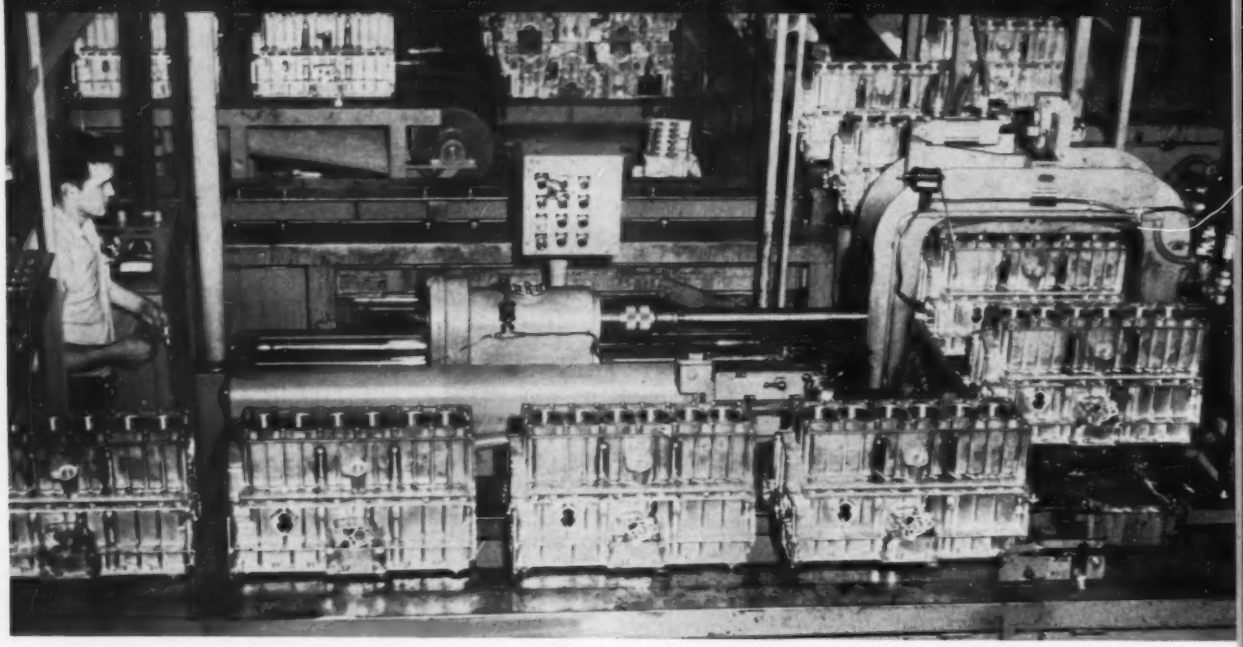
Work-pieces such as diesel-engine nozzles are said to be ground at greatly increased production rates and with much better concentricity, accuracy, and surface finish than ever before on a new double-end internal grinder brought out by the Bryant Chucking Grinder Co., Springfield, Vt. This advanced Bryant machine is specifically designed for grinding both a straight and a tapered bore at a single chucking of the work-piece. Two opposed wheel-slides and a rotary indexing work-table carrying two work-heads permit two work-pieces to be ground simultaneously. These units may be operated simultaneously or individually, as desired. Machine operation is completely automatic, the operator need only load and unload the work-pieces.

Important high-production features of the grinder include new automatic cycling for wheel dressing, compound axial and angular slide that permits reciprocal grinding of the tapered bore, and diamond sizing for both straight- and taper-bore grinding.

Circle 585 on Readers' Service Card

Double-end grinder for processing diesel-engine nozzles

Microhoning main bearing bores

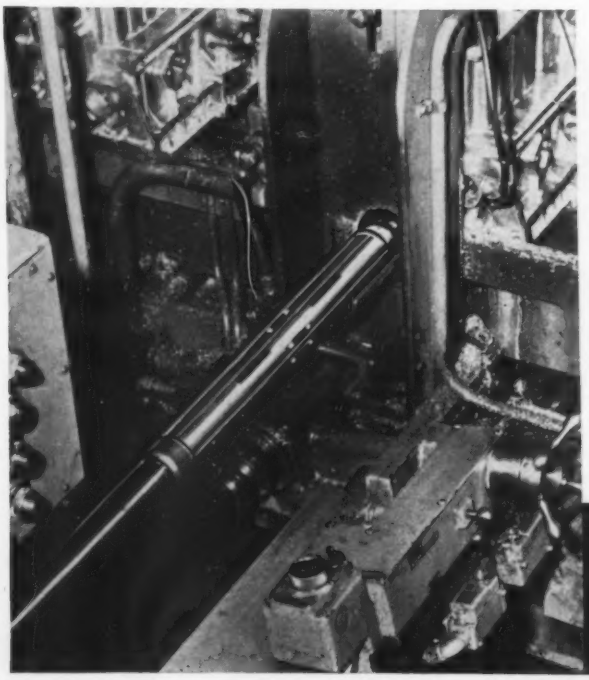


Moving from left to right along the conveyor line, the blocks are shifted laterally by the transfer mechanism at the end of the conveyor section, and then are brought to the Microhoning operation. The two 5HX40 Hydrohoners (the second machine, not shown, is located to the left, behind the operator in the photo) operate side by side. Each machine has a maximum 40" hydraulic spindle stroke and is equipped with automatic sizing controls, automatic stonefeed and stonewear compensating mechanisms, including stonewear indicator and controls.

BORES ARE

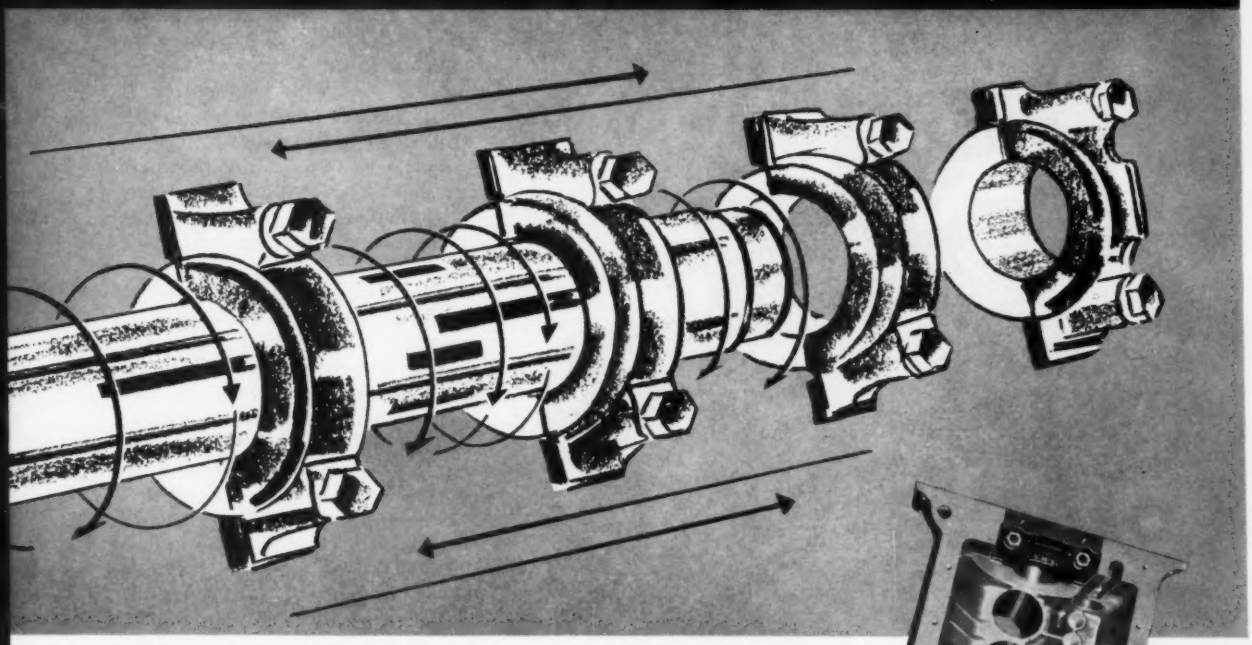
half cast-iron

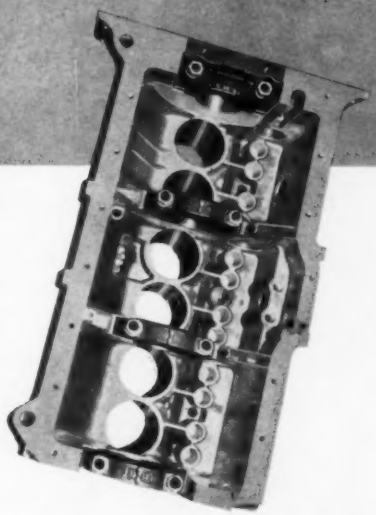
Microhoning produces distortion-free bores and same specified finish in both metals



This is a good view of the Microhoning tool as it is entering the fixture and block. There is a single bank of abrasives in the middle of the tool and five banks of plastic guides (two banks forward and two aft of the abrasives—the fifth is mounted radially between the abrasives). Thus the tool is fully supported at all times and perfect alignment of all four holes is assured. Cycle is automatically ended when hole size is attained by means of an integral sizing device consisting of mandrel and air gage.

at AMERICAN MOTORS





. . . half aluminum

The distinctive characteristics of stock removal, dimensional control and surface finish by Microhoning® are in dramatic evidence in the new American Motors transfer line in Kenosha. For here, in one cycle, Microhoning removes .0025″ of stock from four dual-metal bores with same finish in both metals while maintaining distortion-free hole size and alignment.

The 1961 Rambler Classic cylinder block is die cast aluminum with cast iron bearing caps. Thus half the diameter of the four main bearing bores is aluminum and the other half is cast iron. The difference in machining characteristics and thermal coefficient of expansion for the two metals would normally present some tough processing problems. But the low velocity abrading technique of Microhoning provides the ideal answer.

Surface finish is uniform around the entire diameter and completely free of amorphous metal, grit and chips. Size is held within .0003″, roundness within .0001″, and alignment within .0002″ throughout a length of 24⅜″. The cutting cycle takes only 27 seconds!

In virtually all metalworking industries, Microhoning is gaining recognition for its unique characteristics. No longer looked upon as a "finishing" operation alone, Microhoning is capable of maintaining greater control of size geometry and surface finish even during a roughing cut than any other machining method. Investigate its opportunities for you . . . our national sales engineering staff is well versed in *all* machining methods and can quickly point out the applications where Microhoning can give profits a helping hand in your operations. Why not drop us a line today. Incidentally, if you would like more information about the application described above, send for a copy of "Cross-Hatch" Vol. 13, No. 2.

MICROMATIC HONE CORP.
8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC

Onsrud Introduces Tri-Way and Rotary Mach-Mils and New Heavy Router

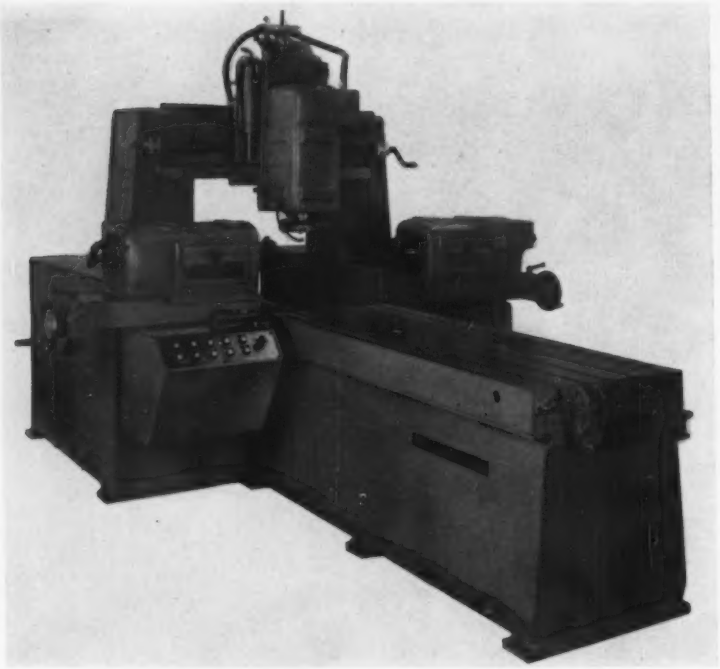


Fig. 1. Onsrud Tri-way Mach-Mil designed to mill three sides of nonferrous work-piece simultaneously

Three machines designed for processing nonferrous metal parts are announced by the Onsrud Machine Works, Inc., Niles, Ill. The Onsrud Tri-Way Mach-Mil, Fig. 1, enables one operator to mill up to three sides of a piece in one pass with one setup. All three sides are automatically milled to accuracies of plus or minus 0.0003 inch and with superfinishes. This feature eliminates cuts that are out of parallel due to shifting of cutter-head or work-piece.

The machine has high-speed cutter-heads with direct drive motors that are said to permit faster cutter speeds than ever before possible on conventional milling machines designed for the nonferrous trade. When using the correct high speed and feed, all heat is transferred to the chip and not to the cutter and work-piece. This results in distortion-free, better finished parts that are held to closer tolerances.

The Onsrud 1024 and 1036 heavy-duty routers, of the design shown in Fig. 2, for machining nonferrous metals have been en-

Fig. 2. Heavy-duty router for nonferrous metals developed by Onsrud Machine Works, Inc.

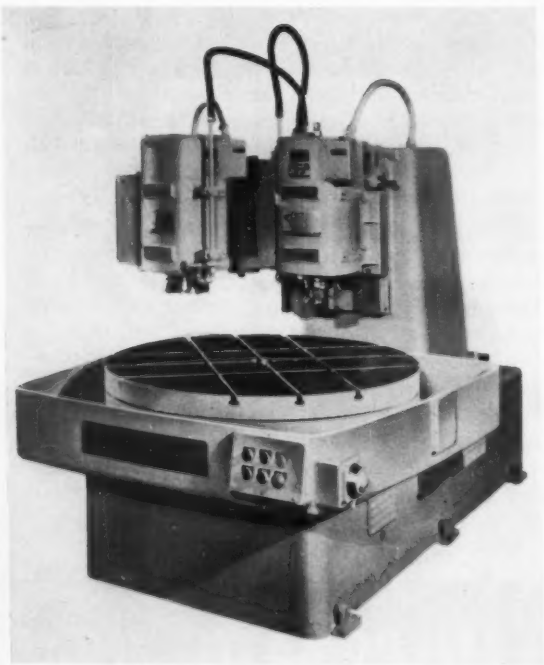
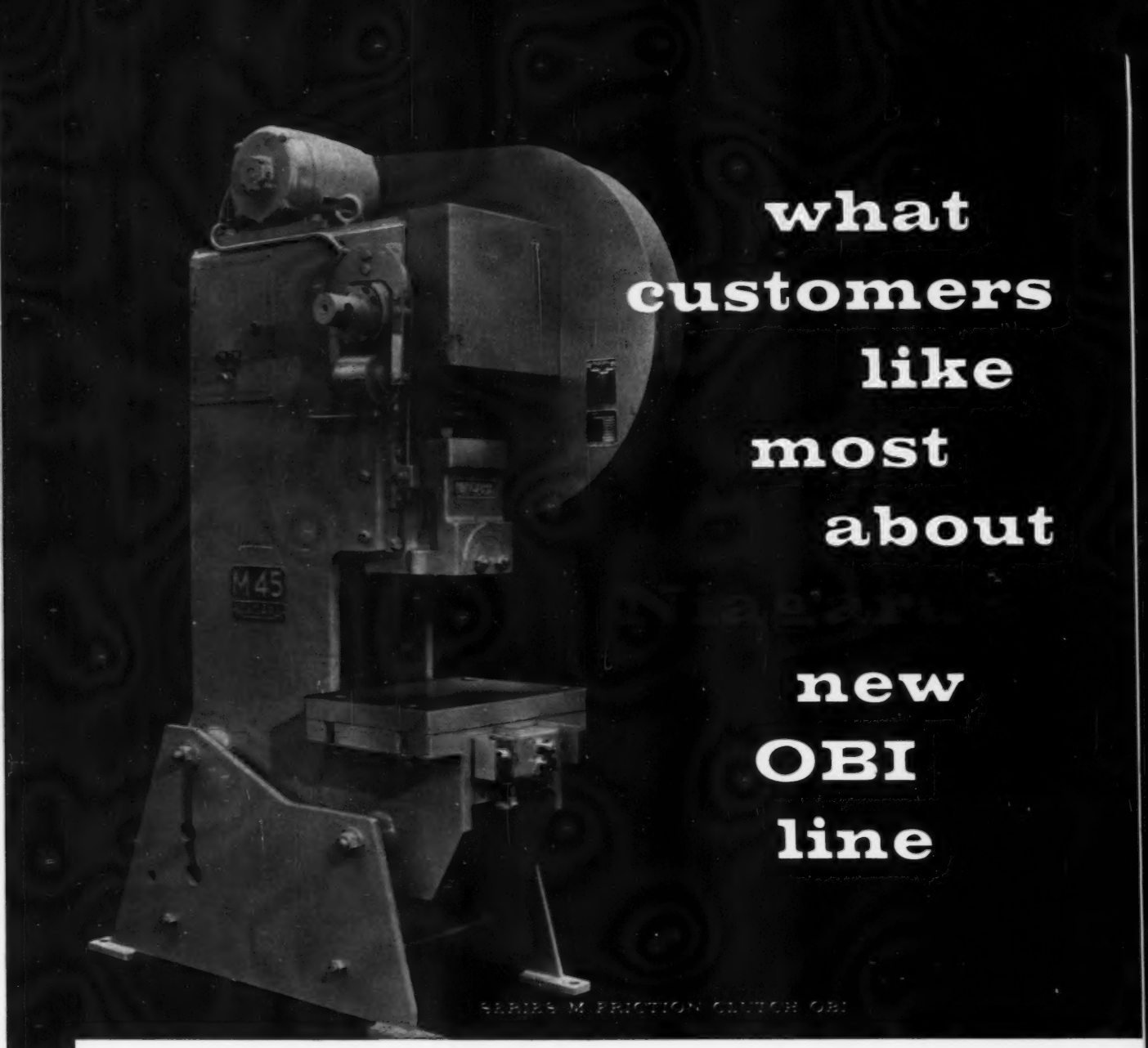


Fig. 3. Onsrud rotary-table milling machine that combines high milling speeds and fast feeds



what customers like most about new OBI line

Already in the field and on the job in substantial numbers, the new Series M is drawing a very significant response from production people. Here, briefly, are the features generating the most comment:

EXTRA RUGGED, NEW WELDED STEEL FRAME . . . surpasses in stiffness even the high standards by which Niagara OBI's have been known for years. Dramatically less vertical and angular deflection prolongs die life, assures uniformity of work.

FULLY ENCLOSED DRIVE . . . improves safety factor by eliminating exposed rotating parts. Front guard shields operator from oil splashes.

COMPACT BUILT-IN PRESS CONTROL . . . assembled with the latest in compact components. Nothing protrudes.

SLOW, LOW ENERGY, POWER-OFF JOGGING . . . When in "Jog" position, the Selector Switch *disconnects main motor*. Pressing 2 palm buttons (both hands) brings slide down slowly and smoothly. A separate motor jog button permits small shots of energy to be restored to flywheel as required. Die-setting is easier, faster, safer.

EXTRA LONG, RIGID SLIDE . . . prevents deflection of guiding ways. Exceptionally generous front-to-back mounting space, with mounting holes in front, rear, and sides, gives dies more solid support. New design provides for circulating oil and keeps oil out of die area.

Niagara Series M OBI Presses are available in 4 sizes (both non-geared and single geared) with shaft diameters from 2½" to 4" and capacities from 22 to 60 tons. A specialized design is built for automatic ultra high speed production. For the full story, send today for Bulletin 54. Niagara Machine & Tool Works, Buffalo 11, N. Y. District Offices and Distributors Everywhere.

NIAGARA

America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work.

gineered for rigidity and versatility. They can handle a wide range of work, including inside cutout, inlet routing, and top-edge routing. Designed for improved performances and lower costs, these routers incorporate massive machine tool construction, large table areas, two-speed electric motor drives, interchangeable spindle assembly and precision, high-speed spindle design. Exclusive features include: a spindle head with floating action that allows it to follow the curves and contours of an irregular piece, automatic cycling that controls the cutting head for repetitive or similar cuts, automatic "no hands" two-depth cycling for two different routing depths, air-powered control of the spindle head, and vertical movement.

The new milling machine (see Fig. 3) for nonferrous face milling which is supplied with attachments for secondary operations, provides the unusual combination of high milling speeds and fast rotary table feeds with a rigidity in over-all construction said to equal that of the finest bed type machine. The result is high productivity and assured accuracy in milling aluminum or any other nonferrous metal. The basic machine is designed with a single vertical head for face milling. A second milling head may be supplied as extra equipment and makes possible, in a single pass, such double operations as roughing and finishing, face milling and profiling, or milling surfaces at two different elevations.

This machine, identified as the Onsrud MM-48 Mach-Mil, is the first of a new series. It is equipped with a specially designed high-speed milling head that provides the high-speed cutter rotation required for milling nonferrous metals, particularly the aluminum alloys. The table has a work-surface diameter of 48 inches. The face-milling head is adjustable vertically in a range of 2 to 15 inches, measured from table surface to spindle nose. The column position is also adjustable, providing a radial adjustment of the milling head relative to the table ranging from 12 to 28 inches, measured from table center to projected axis line of the spindle. One of many milling heads available is a 10-hp motorized spindle unit, operating at a speed of 3600 rpm. High-speed table drives are available in a choice of two speed ranges. The standard rotary-table drive provides an infinitely variable peripheral feed rate of 18 1/2 to 150 ipm, and the optional table drive provides an infinitely variable peripheral feed rate of 37 to 300 ipm.

Circle 586 on Readers' Service Card

Kingsbury Machine for Processing Aluminum Oil-Pump Bodies

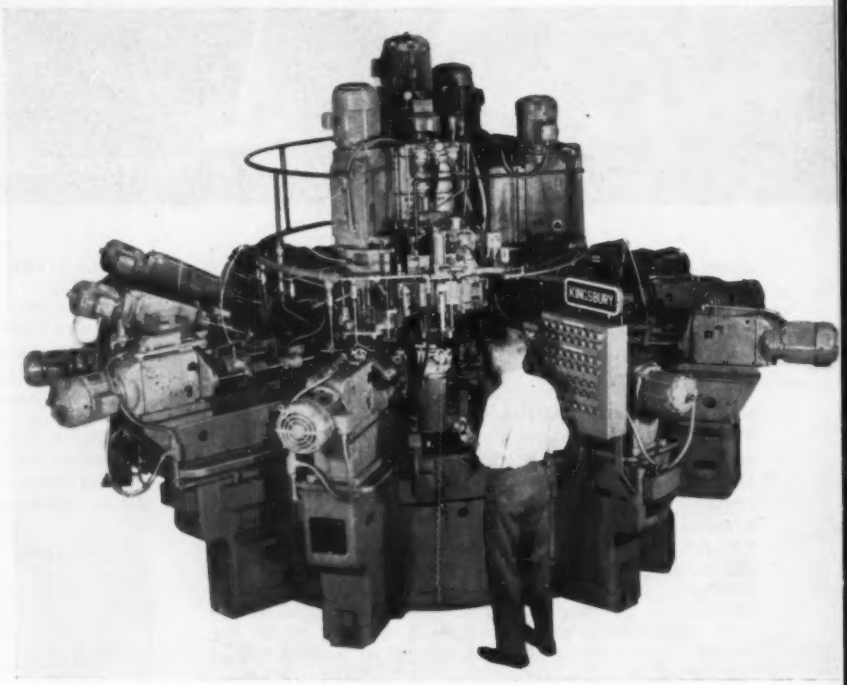
A center-column machine built by the Kingsbury Machine Tool Corporation, Keene, N. H., for the Ford Motor Co. has sixteen units with thirty-three spindles which spot-face, drill, bore, mill, ream, tap, counterbore, and flat-bottom aluminum oil-pump bodies at a gross rate of 240 per hour. A 63-inch index-table holds twelve double-chucking type of fixtures equipped for power clamping and automatic unclamping. Two different styles of oil-pump bodies can be run on the machine.

The first chucking is on the left of the fixture. The work rests in two vees with the axis horizontal. It is clamped down by an arm that is actuated by a spring-loaded ram; an air cylinder unclamps it. In this chucking, two precision boring heads with combination tools rough- and finish-bore the large rotor hole and rough- and finish-face the flange. A motorized spindle mills the mounting pad at a speed of 3600 rpm. Seventeen other tools finish ten holes.

For the second chucking, the main axis is in a vertical position and the flange just finished is down. An equalizing cam actuates two arms that clamp the flange in the down position. A spring-loaded ram, shaft, pinion, and rack actuate the cam.

In this chucking, thirteen tools operate—ten horizontal, one vertical, and two angular. Two of the tools ream with filtered coolant under high pressure to obtain a fine finish. The operator's control panel is equipped with lights that identify any source of trouble.

Circle 587 on Readers' Service Card



Center-column indexing-table machine for processing automotive parts built by Kingsbury Machine Tool Corporation

CUTS MANUFACTURING COSTS OF EXPORT PARTS TO MEET FOREIGN COMPETITION

Assignment was to design and build a machine to process large domestic aluminum transmission covers through one sequence of operations and smaller export covers through a different sequence. One machine to do both jobs would, naturally, save money. The job was slightly complicated by production ratio of one export part to four domestic; the machine to accept these parts intermixed at random and run them through automatically.

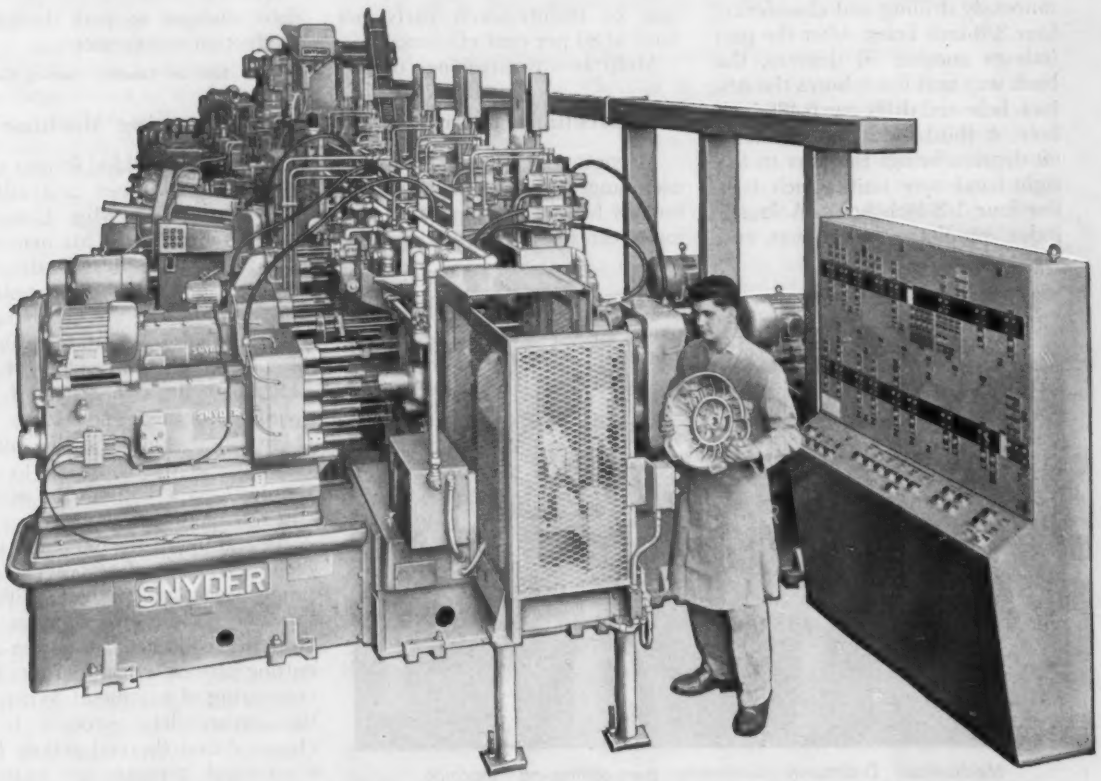
The assignment was carried out successfully and covers made here are built into foreign cars at cost competitive with local production overseas.

The fact is that U. S. experience, know-how, fresh approach and creative ideas *can build and are building* machines to offset foreign cost advantages. And the same cost-cutting techniques can be built into machines to offset regional manufacturing cost differences. Here at Snyder we're particularly experienced in this because we've been designing and building such machines for both domestic and export markets for 35 years. May we help you?

SNYDER

CORPORATION

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

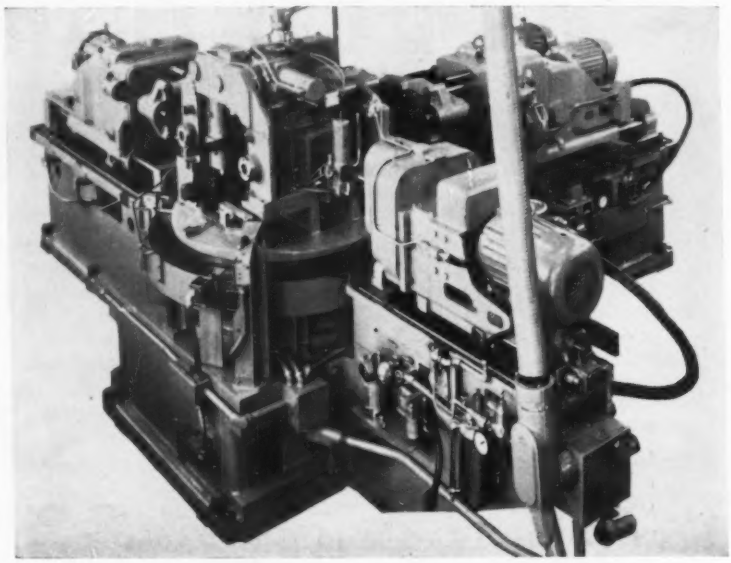


Three-Way Multiple-Spindle Cylinder-Block Drilling and Tapping Machine

The Foote-Burt Co., Cleveland, Ohio, has announced a new three-way, eleven-spindle hydraulic-feed machine for drilling and tapping cylinder blocks and other large components. The three horizontal way units are centered on a four-position power indexing table which carries the work-fixture. After loading, the fixture table indexes, locating the part for each way unit in turn. The fixture unclamps automatically for unloading after the table has made a complete revolution. Each horizontal way unit mounts on a separate wing base, which bolts firmly to the massive cast-iron base of the power indexing table, to form a rigid, unitized machine. All three drill heads slide on exclusive Footburt round ways.

In operation, the part slides into the indexing fixture, which clamps and locates it automatically. The fixture indexes 90 degrees clockwise, and locks to permit the left-hand head to rough-bore and chamfer one 3.8-inch hole, simultaneously drilling and chamfering four 3/8-inch holes. After the part indexes another 90 degrees, the back way unit finish-bores the 3.8-inch hole and drills one 0.438-inch hole. A third index movement of 90 degrees brings the part to the right-hand way unit, which taps the four 3/8-inch holes. A fourth index completes the rotation, and the part is released for unloading. Total cycle time is one and seventy-seven hundredths minutes, equivalent to a production rate of twenty-seven parts per hour at 80 per cent efficiency.

Multiple-way machines of this type can be custom-fabricated with vertical or angular heads, as well as horizontal ones. In addition, milling units can be built into any station. Pick-off gears for speed selection can also be provided for the units, to accommodate changes in part design or production requirements.



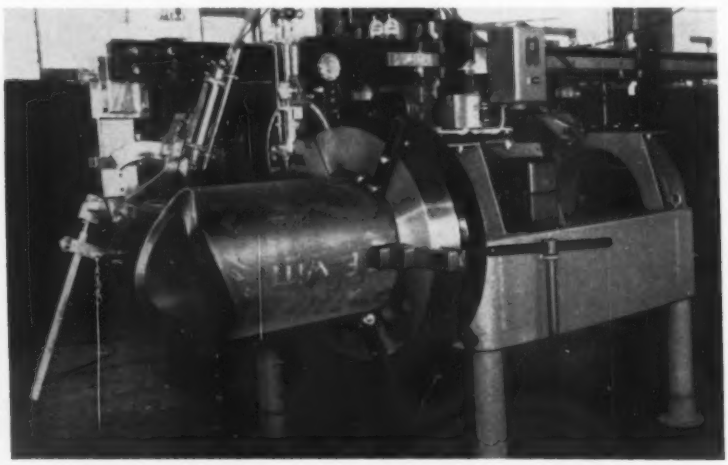
Foote-Burt three-way cylinder-block drilling and tapping machine

Circle 588 on Readers' Service Card

"Mechanical Draftsman" Pipe-Contouring Machine

A contouring machine which uses tungsten-arc or oxyacetylene torches for cutting pipe and tubing to the shapes required for the production of welded fittings such as elbows and tees is available from the Steffan Mfg. Corporation, Salem, Ohio. This machine, called the Mechanical Draftsman, requires no cams or templates and can be set up or changed from one job to another in about fifteen seconds. The operator need only know the dimensions of the required contour. The settings for these dimensions can be made quickly and the work cut to the required shape without the necessity for making drawings.

As equipped, the machine can contour mild steel and steel with minor variations in composition. However, some users prefer to employ a constricted tungsten-arc cutting process, which permits the contouring of any metal. Whereas the oxyacetylene process is a chemical and thermal action, the constricted tungsten-arc cutting process is entirely a thermal ac-



Mechanical Draftsman automatic pipe-contouring machine equipped with variable-beveling attachment

tion, thereby permitting the severing of any metal.

Thus, for example, contours that are ready for welding can be developed on stainless steel, aluminum, copper, and other metals. The Mechanical Draftsman, using Linde's Heliarc cutting process, is able to develop a contour on 6-inch aluminum pipe in about twenty seconds. Stainless steel is contoured with equal facility. Cutting around 20 ipm permits the development of a contour with exceptional speed.

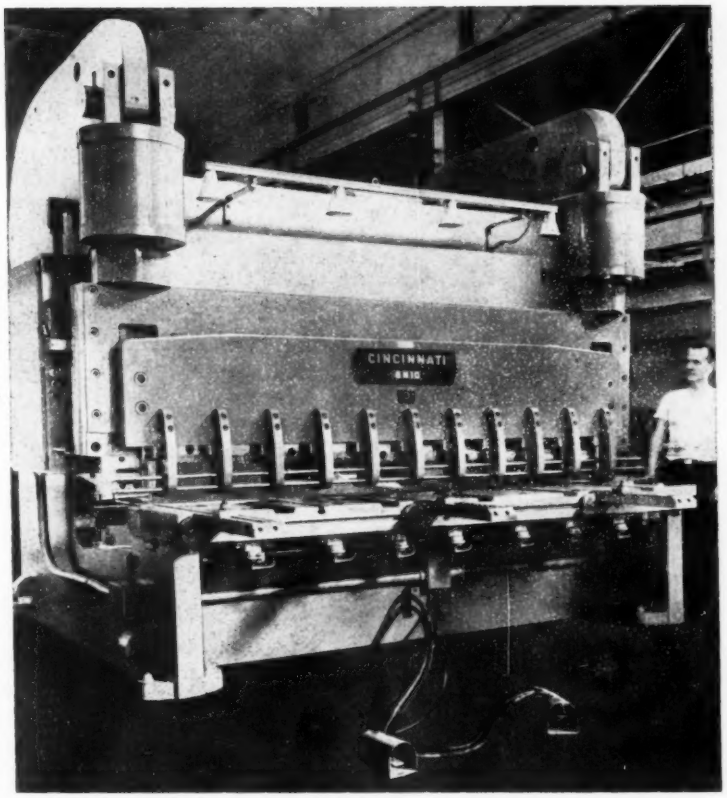
Linde's Heliarc cutting torch can be mounted directly in the ratchet assembly of the Mechanical Draftsman for use in severing any material that will conduct electricity.

In order to provide for a varying bevel of a controlled amount, a "Vari-Beveler" arrangement was designed which permits the development of mathematically precise cuts on the inside diameter of the part being cut. This produces a varying bevel that is best suited for any part of the contour. Where heavy-walled material is used, as shown in the illustration, it is even possible to reverse the bevel in places in order to reduce the amount of weld necessary. The illustration shows a Model 424S with variable-beveling attachment cutting at 35 degrees to the surface of the pipe at the crotch of intersection on a tube having an outside diameter of 15 inches and inside diameter of 10 inches.

A universal fitting positioner is available which permits the trimming of tees and the trimming and contouring of elbows. It is an invaluable piece of equipment insofar as it permits the reclamation of valuable parts. The positioner can be made to handle practically any size elbow or tee up to the limits of each model of the Mechanical Draftsman. Ball steadyrests are provided with the machine. Some users prefer to use a chuck at the machine's rear for precision work.

Structural members in planes and helicopters can be contoured efficiently with the Mechanical Draftsman. With special modifications it can contour tubes down to 1/2 inch in diameter to match tubing 1 3/4 inches in diameter.

Circle 589 on Readers' Service Card



Adjustable-rake hydraulic shear announced by Cincinnati Shaper Co.

Cincinnati Gap-Frame Hydraulic Shear

The Cincinnati Shaper Co., Cincinnati, Ohio, has brought out a Series 8N10 hydraulic shear equipped with its standard "adjustable rake" feature. The nominal capacity of this shear is a 10-foot length of 1-inch thick mild-steel plate. The rake of the upper knife is adjustable from 0 to 7/8 inch per foot. This feature permits the shearing of materials that exceed the nominal capacity of the machine by adjusting the rake upward (thus the maximum mild-steel plate-shearing capacity of the 8N10 is 1 1/4-inch thick plate). When shearing materials lighter than the nominal machine capacity, the rake can be adjusted downward to a low angle to minimize distortion in the back piece.

Centralized controls for the adjustment of rake, stroke, power back-gage and start-stop control are convenient to the operator and simple to operate. Ball transfers in the table facilitate materials handling and provide for greater operator efficiency. The gap frame permits the cutting of plates that are longer than the nominal machine length. Electric foot-pedals permit remote-control of the shear.

The hydraulic drive is powered by a 40-hp motor. The drive unit incorporates a manifold block which brings the valves together in one compact assembly. High-pressure joints are reduced to a minimum. The exclusive Cincinnati clevis-mounted operating cylinders are self-aligning. Automatic horizontal movement of these units throughout the full rake adjustment insures greater life of piston and cylinder packings.

Other important features include: hydraulic hold-downs; light-beam shearing gage; front gages and support arms; work chute at rear of machine; inclined ram; interlocked construction; automatic pressure lubrication; exclusive swivel end-guide bearing that insures ram alignment endwise; four-edge knives; and jack lugs for quick, easy installation.

Circle 590 on Readers' Service Card

from phidias - - to lamb - - to you

Millenniums of time separate the ancient wonder of the statue of Zeus, and the modern multi-station transfer machine. Despite the centuries between them, both are alike in their broadness of concept, one in the field of art, the other in technology.

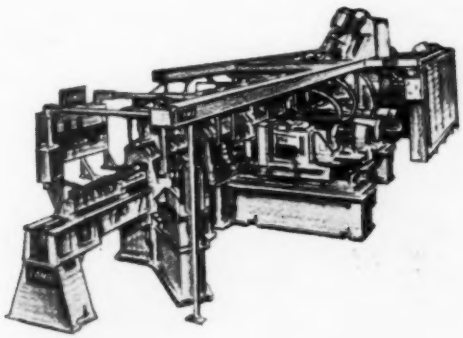
The leaders of ancient Greece selected Phidias to create the statue of Zeus because he alone was capable of a work that expressed their feeling for the Father of the Gods. Today —broadness of engineering concept is mandatory in designing and building high output machinery capable of producing work to precision tolerances and at minimum cost per piece. That is why progressive companies are turning to Lamb for solutions to mass-production manufacturing problems.

Unlike Phidias' Zeus, the result of Lamb's engineering is here – NOW – for all to see and use. Investigate the Lamb concept before you decide on any type of production machinery

Statue of Zeus at Olympia

One of the "Seven Wonders of the Ancient World" . . . masterpiece of Phidias, greatest sculpture of ancient Greece. Forty feet high, this bejeweled ivory giant wore a golden robe and was enthroned in a temple at Olympia. It was carried to Constantinople by the conquering Turks and destroyed by a great fire in 476 A.D.

One of a series of paintings by Mario Larrinaga, commissioned by F. Jos. Lamb Co. Copies suitable for framing available on request.



F. JOS. LAMB CO.

5663 E. NINE MILE ROAD • DETROIT 34, MICHIGAN

Since 1914 Engineers and Builders of Special Machines and Automation Equipment

Fosmatic Preselect Control, housed in a simple console, is shown applied to a Moore-Fosdick jig grinder.

Fosdick Remote "Preselect Control"

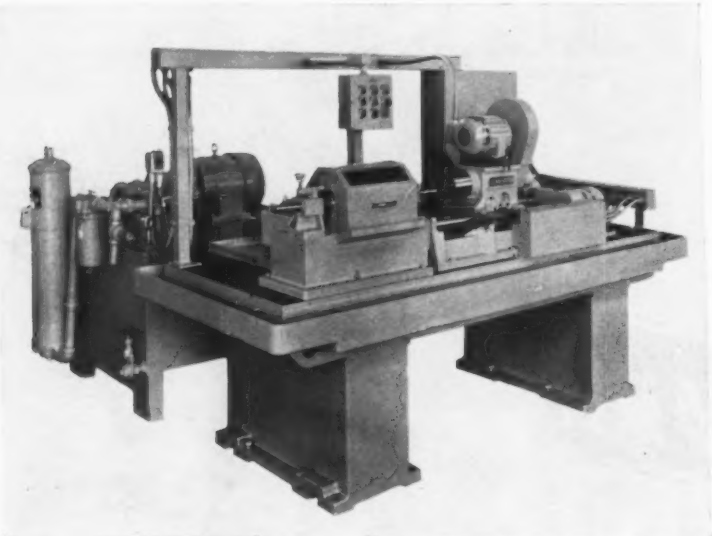
Manufacturers doing jig boring or jig grinding appreciate the advantages of the speed and accuracy obtained by the use of numerical control. However, many feel that the volume of this kind of work handled in their plants does not justify the purchase of full tape-control equipment. In such cases, the new Fosmatic "Preselect Control" announced by the Fosdick Machine Tool Co., Cincinnati, Ohio, offers many advantages.

The Fosmatic Preselect Control is housed in a separate console, displaying on its face a series of numerical dials. While a machining operation is being performed, the operator sets the coordinates of the next operation on these dials. The machine will move to the new location at the touch of a button as soon as the previous operation is finished. This is basic numerical control, with the substitution of manual input for tape input. Otherwise, the control is similar to tape control. In fact, the Preselect Control console is completely interchangeable with the Fosmatic numerical-control console (which offers both tape and manual input). Both are electromechanical systems.

The controlled machines must, of course, be equipped for remote numerical input. Most new Fosmatic precision boring machines and Moore-Fosdick jig grinders are purchased with either manual or tape remote numerical input.

The Fosmatic Preselect Control costs less than numerical (tape) control and eliminates delays in setting locations. Tape control adds the benefits of a tape for checking and repeating operations, and insurance against human errors, such as skipped holes and incorrect locations.

Circle 591 on Readers' Service Card



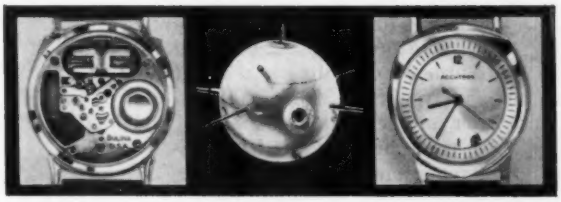
Leland-Gifford fixed-bed gun drill for deep-hole drilling

Fixed-Bed Deep-Hole Precision Gun Drill

A fixed-bed gun drill for deep-hole production drilling that can be supplied with hydraulic or lead-screw feed has been announced by the Leland-Gifford Co., Worcester, Mass. Designed for drilling deep precision holes in ferrous or nonferrous materials, using carbide tipped drills, this new machine is offered with either a self-contained hydraulic feed or a lead-screw feed. The bed can be furnished in appropriate dimensions to accommodate the fixturing for any size or shape of work-piece. This machine is recommended for drilling accurate holes up to 5/8 inch in diameter by 7 inches deep. The self-con-

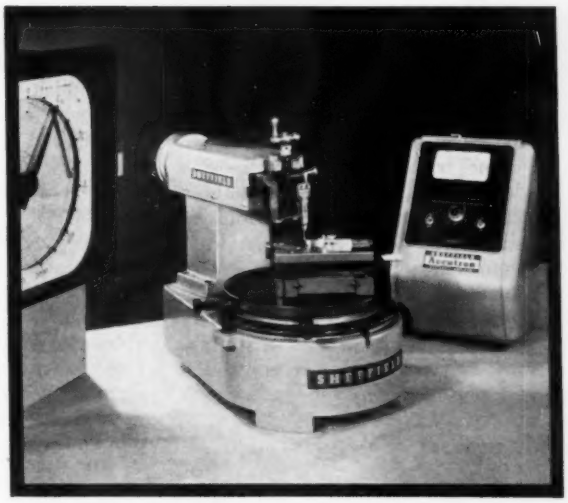
THIS IS ACCUTRON†®

† TIME-KEEPING Great interest has been focused on the new Bulova ACCUTRON timepiece, a watch described by Bulova as "the first instrument of the space age you can wear and use! . . . It doesn't even tick. It hums! First timepiece guaranteed accurate on your wrist." "Accutron" is Bulova's trademark for timekeeping devices. It stands for new standards of accuracy.



® GAGING We welcome Bulova's use of the word "Accutron" as a compliment to the term already distinguished in the field of precision measurement. "Accutron," a Sheffield trademark for gaging devices, has long been a symbol of unquestioned accuracy and reliability. The Sheffield Accutron amplifier, for example, can show dimensions down to two and a half millionths of an inch, and is readily adaptable to an almost unlimited range of electronic gaging heads and tooling, for checking almost any dimension, shape, or relationship. Feathertouch gaging heads (with pressures as low as 5 grams) permit reliable measurements of soft or easily distorted parts. Accutron instruments are in constant service in Sheffield's own Eli Whitney Metrology Laboratory.

Your Sheffield representative can give you prompt competent technical assistance in any phase of your gaging needs. Write for the Sheffield catalog on ACCUTRON gages and accessories.



The **SHEFFIELD** *Corporation* *Dayton 1, Ohio*

A subsidiary of The Bendix Corporation

Inspection Gages, Dimensional Control Instruments, Machine Controls, Automatic Gaging & Assembly Systems, Measuray® X-Ray Thickness Measuring, Crushtrue® & Multiform® Grinders, Cavitron® Ultrasonic Machine Tools, Press-Pacer® Transfer Units, Large Dies, Tooling, Contract Manufacturing.

tained hydraulic feed unit offers the advantages of a highly uniform feed rate with simple feed-rate changing. Pump and spindle are independently powered with a 1 1/2-hp totally enclosed spindle motor which transmits power through a timing belt drive. For general use, variable-speed drives are available for speeds up to 10,000 rpm.

For holes having a depth greater than 7 inches, the Leland-Gifford No. 24C "Electro-Mechanical" gun drilling unit can be furnished with a 12-, 24- or 36-inch stroke. Driven by a 1 1/2-hp Dynabrake motor through a nonslip timing belt, the spindle can be run at speeds from 720 to 12,000 rpm with a motor operating at a speed of 3600 rpm, or at 360 to 6000 rpm with a motor having a speed of 1800 rpm. Feed is actuated by and synchronized to the spindle speed and can be changed through pick-off gears from a minimum of 0.00019 ipr to a maximum of 0.0015 inch in increments of 0.000015 inch, if desired. A separate 1/2-hp Dynabrake motor powers the lead-screw and makes possible rapid approach for setup and rapid return.

This gun-drilling equipment can be furnished as a complete machine, with base and hydraulic or lead-screw feed, with or without tooling for specific operations, or as drilling units only on a do-it-yourself assembly basis. Also available is a high-pressure coolant system with an oil capacity of 100 gallons, capable of supplying a constant, closely controlled supply of clean oil under high pressure.

Circle 592 on Readers' Service Card

Hydraulic Rotary Screw Pump, Worm-Gear Reducers

Reliable performance and quiet operation are outstanding features claimed for hydraulic pump, worm-gear speed reducers exhibited by the De Laval Steam Turbine Co., Trenton, N. J., at the recent Design Engineering Show in Detroit. The De Laval IMO pump exhibit highlighted major design considerations in choosing suitable pump characteristics for power hydraulic service. The smooth rolling action of the IMO pump serves to eliminate noise, vibration, and hydraulic whine.

Installed on almost all Navy combat vessels as a lube-oil and fuel-oil pump, the IMO is claimed to be the only pump that has proved acceptable for integral mounting on high speed machinery. Standard IMO pumps have given dependable, quiet operation at speeds up to 12,000 rpm and delivered up to 3000 rpm at 300 psi in a continuous, nonpulsating flow.

Virtually standard equipment for hydraulic passenger elevators and Navy submarine hydraulic service, the wide range of capacities and pressures of these units makes them exceptionally well-suited for hydraulic press applications. Pulsation-free flow, for example, can help prevent finish errors on broaching operations. The IMO pump will also handle fire-resistant fluids such as phosphate ester and water glycols without difficulty.

Circle 593 on Readers' Service Card

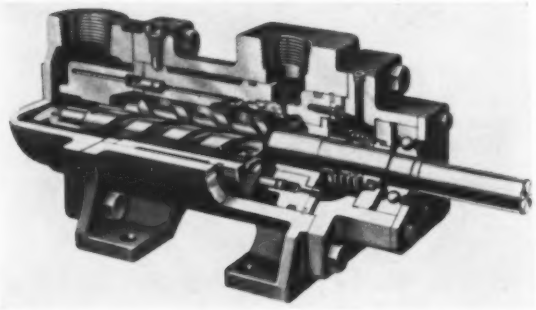
Compact, Lightweight, High-Speed Grinders

Lightweight, high-speed Series 15 air-driven grinders developed to reduce production time, minimize operator fatigue, and provide easy access to all areas of the work-piece in metal grinding or buffing have been announced by Ingersoll-Rand, New York City. The twelve new grinders measure only 16 5/8 to 18 inches long and weigh 6 1/2 to 7 1/4 pounds. The high-speed tools have free speeds of 6000, 9000, 12,000, and 15,000 rpm to provide for rapid finishing and minimizing of job time. A choice of grip or straight handles and thumb or lever throttles enables easy handling on a variety of jobs. A wide selection of equipment for using a variety of wheels with these tools gives the user practically a custom-designed tool for his particular operations, which can be adapted to other uses.

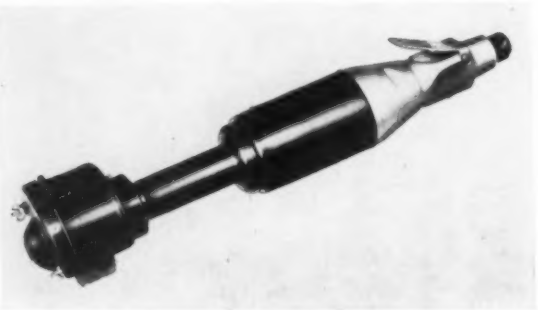
Excellent power-to-weight and size ratios result from the compact design of these new grinders. The motor is longer, but only slightly larger in diameter, thus giving increased power and, at the same time, keeping the all-important side-to-center distance down to only 1 5/16 inches. These tools offer a completely new size and power range in the line of Ingersoll-Rand grinders. A closed-face wheel guard provides maximum operator protection.

Improved muffler design keeps operation about 15 decibels quieter than previous comparable tools. A sensitive weight type governor assures accurate speed control.

Circle 594 on Readers' Service Card



De Laval IMO pump for power hydraulic service



Ingersoll-Rand new Series 15 air-driven grinder

If gears rotated the world...

CINCINNATI

CUSTOM GEARS AND GEAR BOXES assure this kind of *dependability*. They are precision made, guaranteed to meet your specifications exactly!

Ask for this brochure—CINCINNATI custom gears are made in all types to 72" diameter cut teeth, 39" shaved teeth, 25" ground teeth.

better still... Send us your prints for quotation

CINTI®

THE CINCINNATI GEAR CO.

Cincinnati 27, Ohio

Custom Gear Makers Since 1907 GEARS, good gears only

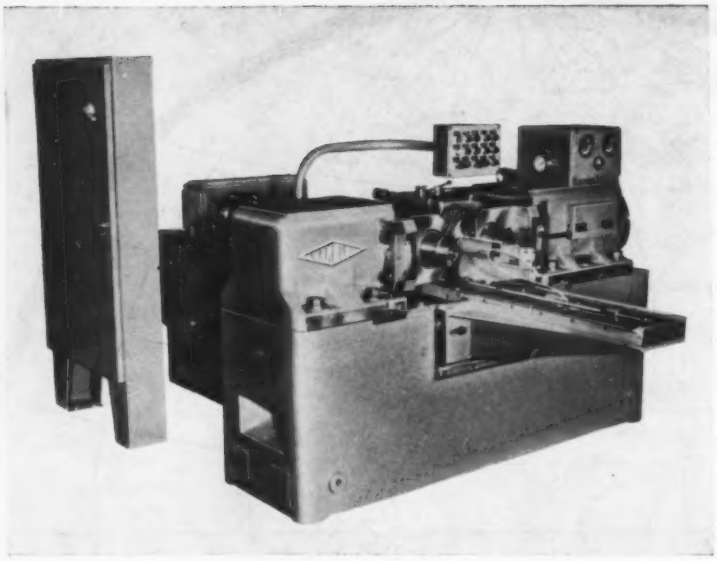


Fig. 1. Hy-Duty thread-rolling and forming machine built by Landis Machine Co.

Landis Hy-Duty Thread-Rolling and Forming Machine

A Hy-Duty thread-rolling and forming machine (Fig. 1) designed for the heaviest thread-, form-, spline-, and gear-rolling applications requiring rolling forces of up to 200,000 pounds has been announced by the Landis Machine Co., Waynesboro, Pa. The nominal diametrical capacity of this machine is from 0 to 6 inches for infeed rolling and from 0 to 4 inches maximum diameter for through-feed rolling. Thread lengths of 11 1/2 inches are obtainable by infeed rolling and up to 20 feet for through-feed rolling.

With hydraulically operated, infinitely adjustable, and electronically controlled infeed cycling and variable infeed stroke length, the machine is exceptionally versatile in its applications and offers power, rigidity, and speed for maximum efficiency within its rated capacity. To withstand the machine's high rolling-force capacity the spindles are made 4 1/2 inches in diameter of heat-treated alloy steel (see Fig. 2). As heavy-duty rolling requires large bearings, the thread rolls must also be of large size, ranging up to 12 inches in diameter by 12 inches in length. However, where the work to be rolled does not demand such heavy-duty equipment, replaceable spindle units with 3-inch diameter spindles can be furnished to permit the use of smaller, less expensive dies up to 8 inches in diameter.

The power transmission has a 50/25-hp motor with a speed rating of 1800/900 rpm obtained

(Continued on page 182)

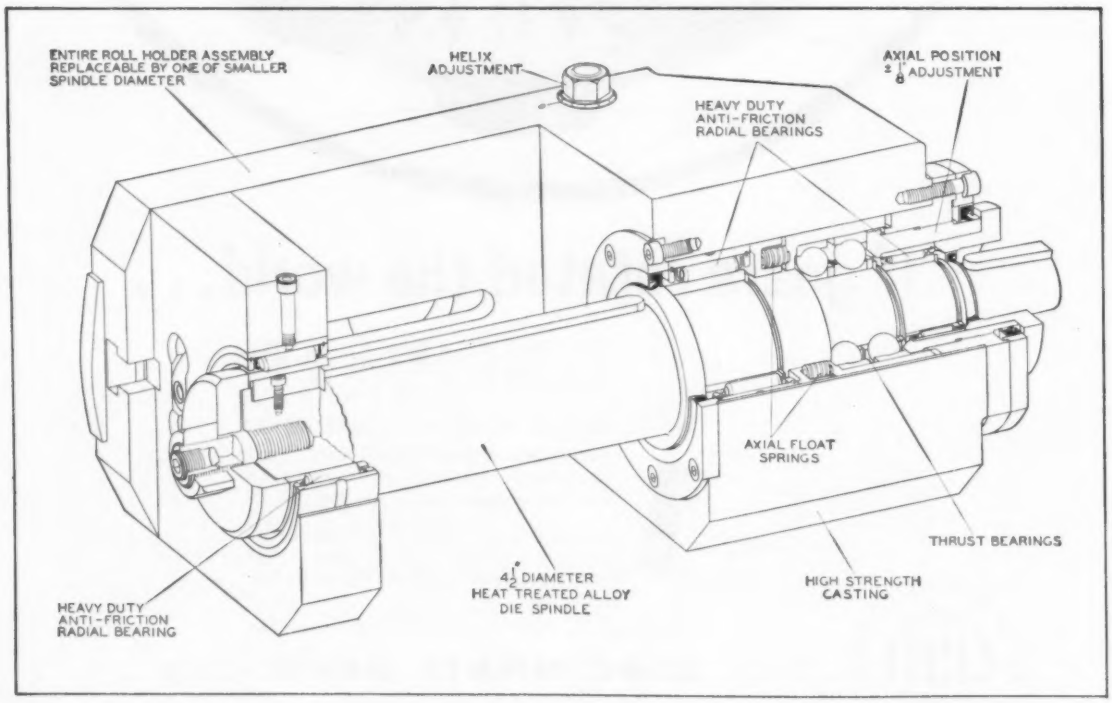


Fig. 2. Cutaway view of spindle of Landis thread-rolling machine, Fig. 1.

Simplified method of checking for

GEAR ANGULAR ERROR

RICHARD L. THOEN
General Mills, Inc., Minneapolis, Minn.

Experience has shown that the great bulk of angular error patterns are relatively smooth. As a consequence, the maximum angular error can be established with about 10 readings. Thus, instead of a separate indexing instrument, angular error can be checked with a small optical polygon mounted directly on the gear mounting arbor (or gear shaft), Fig. 1, thus eliminating the bothersome measurement errors due to (a) runout of an indexing spindle, (b) the driver coupling between an indexing spindle and the gear mounting arbor (or gear shaft) and (c) skewness between an indexing spindle axis and the gear axis. It should be noted that the polygon mounting is not critical. A decentered polygon introduces no error, and the effect of wobble is usually insignificant.

Gear roll tester used

A gear roll tester is ideally suited for checking angular error, Fig. 2. The measuring slide is set to the proper center distance (i.e., to the center distance at which the pawl contacts the work gear inside form radius) and locked. The polygon is mounted on the gear mounting arbor (or gear shaft). The gear and pawl are mounted in the roll tester, the micrometer brought to the mid-position and the autocollimator is zeroed on a polygon face. To measure angular error, the pawl is rotated out of mesh, remeshed so as to bring an adjacent face into view, and the angular error is read in the autocollimator. The friction in the mounting centers is sufficient to keep the driven profiles in contact with the pawl.

In cases where the number of work gear teeth is not a multiple of the number of polygon faces, a slight pawl rotation (never more than ½ tooth) is necessary. If the number of pawl teeth is not less than 40 (on a full circle), the pawl rotation will never exceed $\pm 4.5°$. Over this range, for a suitable arm length, it is usually permissible to use the approximation 0.001 inch/minute of arc in presetting the pawl.

If desired, peak readings can be checked for the possibility of higher peaks by comparing changes in micrometer settings against corresponding changes in autocollimator readings.

A side advantage of checking for angular error on a gear roll tester is that erratic readings can be checked for dirt and burrs by simply releasing the measuring slide lock and reading the tooth-to-tooth composite error.

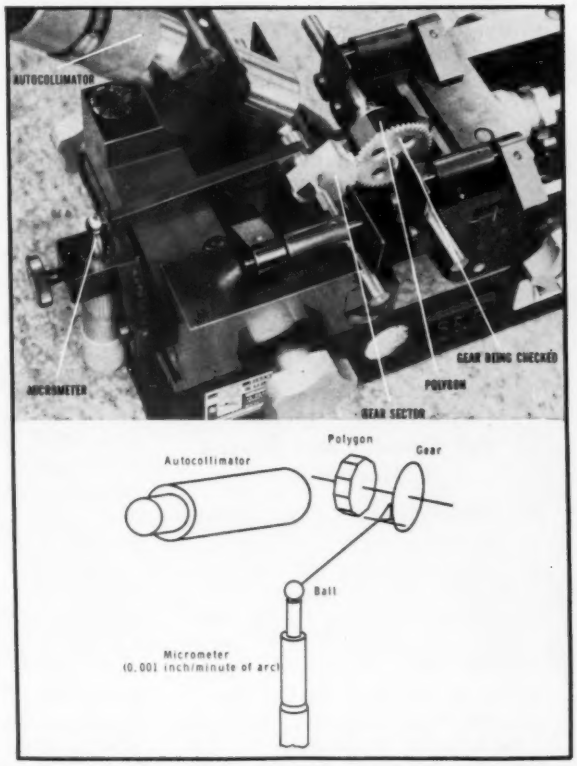


FIG. 1. A simplified method of checking for gear angular error.

FIG. 2. An S & F gear roll tester set-up for checking angular error.

The foregoing was extracted from a paper presented at the International Conference on Gears and Gear Drives held at Essen, West Germany, October 18 and 19, 1960. It is presented here as a service to the fine-pitch gear industry. Reprints are available on request to Gear Division, Kurt Orban Company, Inc. 42 Exchange Place, Jersey City 2, N. J.

through speed change-gears. Six standard speeds are available from a minimum of 78 to a maximum of 476 rpm for the 50-hp range and from 39 to 233 rpm for the 25-hp range. The worm-gear transmission and speed-change gear-box are rated as 90 per cent efficient at maximum speed.

For infeed rolling, the thread rolls can be cycled manually, semiautomatically, or automatically. Infeed cycling rates of up to 25 strokes per minute (fully automatic) are obtainable. The machine bed is fabricated of steel, with the major bed being of 3-inch plate for maximum mechanical stability.

Circle 595 on Readers' Service Card

True-Trace Attachment for Turning and Boring Machines

A True-Trace Mark X VTL tracing attachment designed to convert a vertical turning and boring machine into a contour turning lathe is announced by the True-Trace Corporation, El Monte, Calif. This compact attachment can be mounted on the ram or turret of the machine, or it can be installed in place of the side head, depending upon the individual machine and job requirements. Being an attachment, no machine conversion is required. When not employed for tracing, the machine can be used as a conventional vertical turning and boring machine by removing the attachment.

Contour outside- and inside-diameter machining and facing operations are easily accomplished, as the True-Trace attachment may be universally mounted so that it is positioned with the cutting tool to the right or left without disassembly of the unit. The attachment is hydraulically operated, using the servo-valve and cylinder principal as employed in other True-Trace tracer control systems. It is supplied complete with slide assembly, tracer, template rail, and hydraulic power unit, including all lines and fittings.

Circle 596 on Readers' Service Card

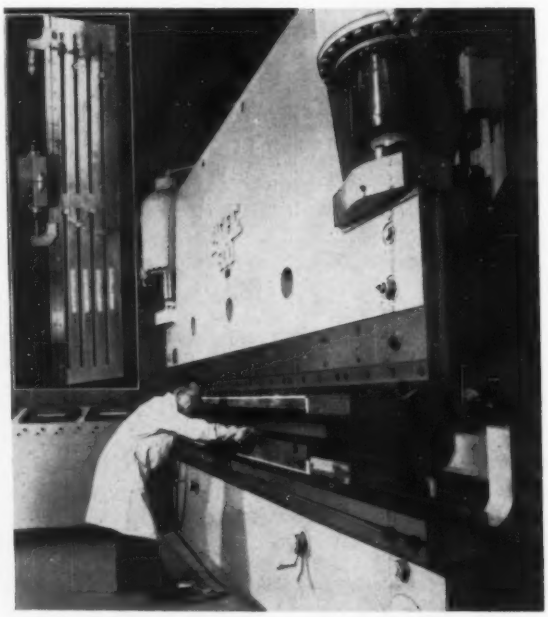
Hydraulic Press Brake Designed to Develop Forming Techniques for Exotic Metals

A fully automated, 500-ton hydraulic press brake built by the Pacific Industrial Mfg. Co., Oakland, Calif., is being used to facilitate research into new high- and low-temperature metal-forming techniques and processes at the Boeing Developmental Center, Seattle, Wash. This work is an important step in the utilization of new high-strength, heat-resistant superalloy and refractory metals employed in advanced air and space craft. The press can be adjusted to maintain precise control over all variables affecting forming: times, temperatures, pressures, and metal-forming speeds.

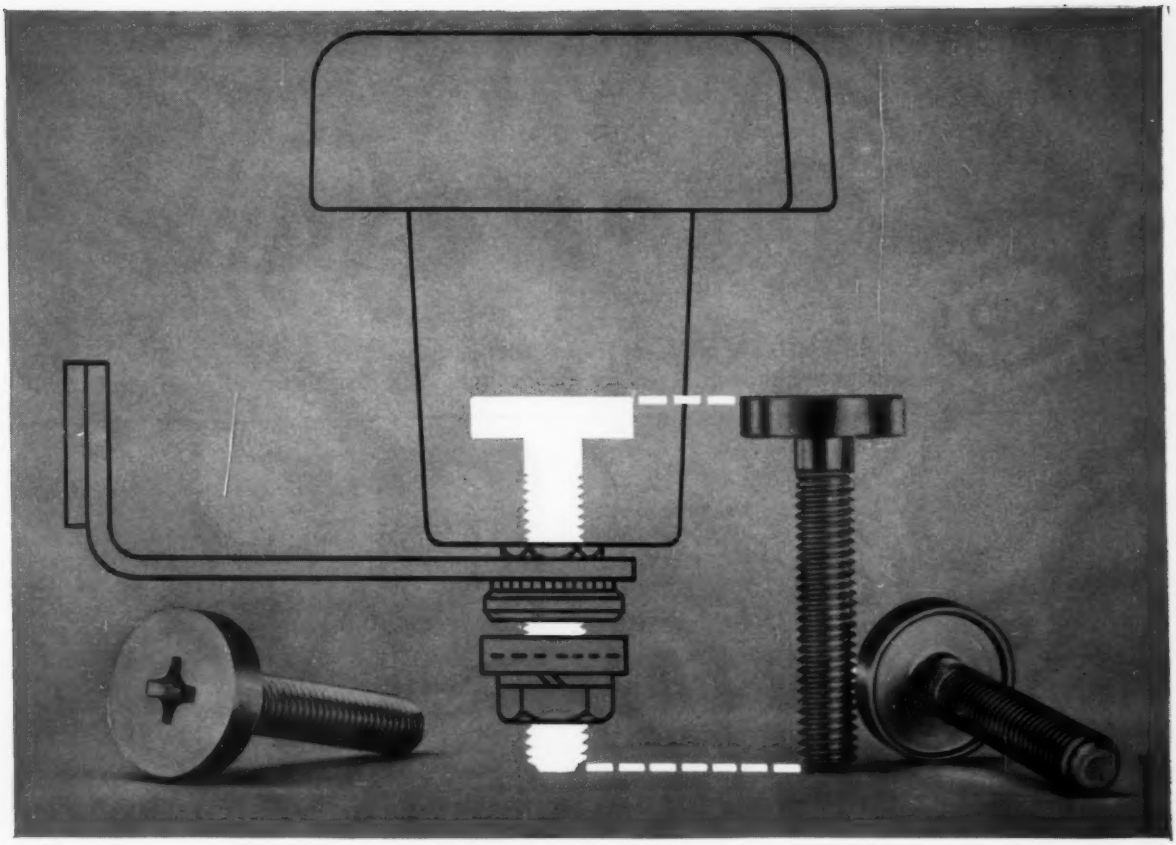
The 8-foot U-channel shown in the illustration was used in connection with a titanium component adaptability program. The die is enclosed, top and bottom, in heated die-holders. The perforated covers at the ends of the die-holders are ventilated wiring connection boxes. The holders are heated by tubular electrical resistance heaters. Other Boeing manufacturing development programs have included investigations into elevated-temperature forming of molybdenum and titanium alloys.

Circle 597 on Readers' Service Card

Tracing attachment for turning and boring machines announced by True-Trace Corporation



Pacific press brake used at Boeing Developmental Center for advanced research work



CUNISIL, new Anaconda copper-nickel-silicon alloy, gives you high strength for tough electrical jobs

THE PROBLEM: The studs for Line Materials Secondary Class Lightning Arresters (illustration above and below left) call for an unusual combination of properties. They must have high physical strength for structural reasons and to handle the stresses of high surge currents. Yet they must also have relatively high electrical conductivity. And for economical fabrication, the alloy must have good cold-forming characteristics and be readily machinable.

LINE MATERIALS Type S-3 Secondary Class Arrester with stud of Cunisil, copper-nickel-silicon alloy. Cunisil is also used for lower studs of Line Materials Protective Gaps.

THE SOLUTION: Continental Screw Company, which makes the studs for Line Material Industries, found the answer in Cunisil-837, Anaconda's versatile new high-strength, heat-treatable alloy with these valuable properties in the precipitation-hardened condition:

Tensile strength—psi min.	90,000
Yield strength—at .50% extension under load, psi min.	70,000
Elongation in 4 x D, min.	8%
Machinability, (Free Cutting Brass=100)	40
Electrical Conductivity, % IACS, as heat treated	30 to 42

In addition, Cunisil-837 has corrosion resistance comparable to copper and Everdur® copper-silicon alloys—and is easy to work cold before heat treatment.

METALLURGICAL COMMENT. Most of the nickel and silicon in heat-treated Cunisil is present as an intermetallic compound, nickel silicide, and it is the precipitation of nickel silicide in the form of particles of submicroscopic size by a relatively low temperature heat treatment that accounts largely for the distinctive properties of the alloy.

Prior to the hardening heat treatment, the alloy is brought to a proper condition for hardening with a solution anneal at a much higher temperature and then a water quench from this temperature; at this stage the alloy is quite soft and in a condition for drastic cold-working operations. The hardening heat treatment consists of heating at a controlled temperature for a definite length of time to obtain the desired mechanical properties.

For more information—see your Anaconda American Brass representative, or write: Anaconda American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

6149

ANACONDA®

COPPER AND COPPER ALLOY MILL PRODUCTS

Anaconda American Brass Company

Isabel Shamlian
Charles O. Herb, Jr.

NEW CATALOGUES

Catalogues bring details of new products to prospective buyers in clear, concise form. Yours for the asking . . . use postcard inside back cover

Heavy Machine Work

New England Butt Co., Providence, R. I. Catalogue covering equipment for handling all types of heavy machine work. Turning, boring, drilling, planing, metalizing, grinding, milling, splining, thread-milling operations, etc., are included.

Circle **Item 501** on Inquiry Card

Power Cylinder Accessories

Hannifin Co., Des Plaines, Ill. Bulletin on a method for quick identification of mounting accessories for square type industrial hydraulic and pneumatic power cylinders—female rod clevis, female rod eye, clevis bracket, mounting plate, etc.

Circle **Item 502** on Inquiry Card

Tool Bits

Firth Sterling Inc., Pittsburgh, Pa. Catalogue (Section 60-100) on high-speed tool bits. Three standard grades are covered, with analyses, recommended uses, sizes, standard package quantities, and prices. Included is a grade-selection guide.

Circle **Item 503** on Inquiry Card

Cutoff Wheels

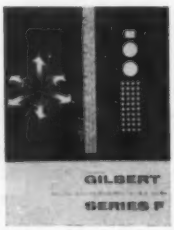
Dayton Safety Grinding Wheel Division, Simonds Worden White Co., Dayton, Ohio. Bulletin providing information on a line of cutoff wheels, including suggested specifications for specific applications as well as several hints on proper operation.

Circle **Item 504** on Inquiry Card

Cemented Carbide

Kennametal Inc., Latrobe, Pa. Booklet featuring a cemented carbide said to have three times the stiffness of hardened steel. Typical uses include components for chemical processing equipment, ordnance, aircraft, missiles and rockets, etc.

Circle **Item 505** on Inquiry Card



Boring Mills

Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio. Bulletin 1260 discussing the "F" series table type horizontal boring mills. Covered are two types of pendant controls, automatic positioning, tracer controls, numerical controls, and accessory equipment.

Circle **Item 506** on Inquiry Card

Punch and Die Sharpener

Punch Products Corporation, Buffalo, N. Y. Catalogue 1125 describing and illustrating the Unipunch universal punch and die sharpener. The self-contained, portable bench type sharpener is said to insure continuous punching of burr-free holes.

Circle **Item 507** on Inquiry Card

Quick-Change Tooling System

DeVlieg Microbore Division, Royal Oak, Mich. Brochure No. FC-2-61 covering a quick-change tooling system for reducing machine tool down time and increasing individual operator output. Built-in features of "Flash-Change" tool-holders are described.

Circle **Item 508** on Inquiry Card

Universal Plugs

Moore Products Co., Philadelphia, Pa. Bulletin 8009 covering universal plugs for Moore pneumatic comparator gages. Dimensions, stamped size, wear-surface diameter, scale values, special nozzle clearance, three-nozzle plugs, etc., are discussed.

Circle **Item 509** on Inquiry Card

Temp-Lok Process

Temp-Lok Corporation, Huntington, Ind. Catalogue containing details on the Temp-Lok process, a method of increasing the strength and wear resistance of high-speed-cutting tools and die steels by reorientation of the atoms in the crystal.

Circle **Item 510** on Inquiry Card

• Yours for the asking . . . use postcard inside back cover

Grinding Wheels

American Emery Wheel Works, Providence, R. I. Brochure outlining a range of vertical-spindle surface-grinding wheels and segments. Pictured are segment shapes, bonds, and abrasives available, with their work applications and exclusive advantages.

Circle **Item 511** on Inquiry Card

Grinding Wheels

Simonds Abrasive Co., Philadelphia, Pa. Catalogue sheet providing data on plain cylindrical grinding wheels for precision work. Wheel speeds, work speeds, rate of traverse, infeed, and coolants are covered. A specification table is included.

Circle **Item 517** on Inquiry Card

Welding Units

Acro Welder Mfg. Co., Milwaukee, Wis. Bulletin No. 261 illustrating sixty-eight welding units, with brief captions where necessary to describe the specific function of each one. Acromatic, Acro-Arc, Acro-Magnetic welders, etc., are covered.

Circle **Item 512** on Inquiry Card

Motors

Reliance Electric & Engineering Co., Cleveland, Ohio. Bulletin B-2515 covering the complete line of Reliance "Duty Master" alternating-current motors from 1 to 2000 hp. Also featured is a description of the company's production facilities.

Circle **Item 518** on Inquiry Card

Punches and Dies

F. J. Stokes Corporation, Punch and Die Division, Philadelphia, Pa. Bulletin 455 giving data on the company's expanded facilities for designing and producing precision punches and dies for customers engaged in a wide variety of forming operations.

Circle **Item 513** on Inquiry Card

Spade Drills

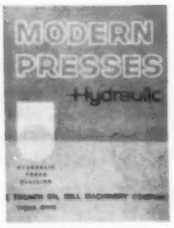
Erickson Tool Co., Solon, Ohio. Catalogue providing data on the company's line of inserted-blade spade drills and spade-drill holders. Dimensions and prices for three standard spade-drill blades—spade, core, and three-lip types—are given.

Circle **Item 519** on Inquiry Card

Drill Presses

Electro-Mechano Co., Milwaukee, Wis. Bulletin providing details on the company's line of high-speed precision drill presses, which are used for print-circuit work, instrument and jewelry manufacturing, and secondary screw-machine operations.

Circle **Item 514** on Inquiry Card



Presses

French Oil Mill Machinery Co., Piqua, Ohio. Bulletin P95 showing some of the various phases and types of hydraulic presses which the company has built. Standard hot-plate, molding, and metal forming and drawing presses are discussed.

Circle **Item 520** on Inquiry Card

Keyseater

Star Cutter Co., Farmington, Mich. Catalogue SC-158 featuring the firm's Model 0 keyseater, an automatic-feed machine for producing precision keyways up to 1 1/4 inch wide and 9 inches long in toolrooms and low and medium-rate production operations.

Circle **Item 515** on Inquiry Card

Presses

Dake Corporation, Grand Haven, Mich. Bulletin presenting details on the firm's movable-frame presses, which provide for complete movement of the work-head. Specification charts for both the single- and double-acting models are included.

Circle **Item 521** on Inquiry Card

Motor Couplings

Link-Belt Co., Chicago, Ill. Folder 2975 describing MC geared flexible motor couplings. Included are a new corrosive-duty cover that is resistant to acids, alkalies, and solvents; a new spacer adapter; and a larger size added to the line.

Circle **Item 516** on Inquiry Card

Steel

Vanadium-Alloys Steel Co., Latrobe, Pa. Folder describing cast-to-shape steel products. The company's facilities for producing castings through the use of conventional sand casting, shell molding, or the ceramic (Shaw) molding process are covered.

Circle **Item 522** on Inquiry Card

• Yours for the asking . . . use postcard inside back cover

Milling and Drilling Accessories

Beaver Tool & Engineering Corporation, Gaylord, Mich. Catalogue presenting information on "Ogesto Quick Change" and "Beaver Quick Change"—two lines of shank milling, drilling, and boring accessories. Calibore boring units are also described.

Circle **Item 523** on Inquiry Card

Dresser

Landis Tool Co., Waynesboro, Pa. Bulletin TD-60 featuring data on the company's Truform shake-free dresser, which makes it possible to dress a grinding wheel to exactly the same shape as the profile bar without the necessity of honing the bar.

Circle **Item 524** on Inquiry Card

Cutting Tools

Wetmore Tool & Engineering Co., Los Angeles, Calif. Catalogue No. 61 gives a description of gun drills, standard boring tools, We-Bor tool-holders, pipe reamers, end mills, indexable milling cutters, an adjustable-center holding fixture, etc.

Circle **Item 525** on Inquiry Card

Rolled Worm Threads

Landis Machine Co., Waynesboro, Pa. Booklet describing the general rules of design and practice for rolled worm threads. Depth-to-diameter ratio, effect of number of work-piece starts on straightness, end feeding and allowances, etc., are covered.

Circle **Item 526** on Inquiry Card

Gun-Drilling and Boring Machines

Drillmation Co., Inc., Centerline, Mich. Brochure containing data on the company's special gun-drilling transfer machines and gun-boring, gun-drilling, tapping, reaming, drilling, and boring power units. Included are charts and data sheets.

Circle **Item 527** on Inquiry Card

Socket Screws

Bristol Co., Waterbury, Conn. Catalogue No. 783 on the firm's socket screws with Nylok self-locking insert. Included is technical data on the properties of the nylon, pellet size and location, and dimensional standards available from stock.

Circle **Item 528** on Inquiry Card

Chuck Jaws

Royal Machine & Tool Corporation, Berlin, Conn. Bulletin JR361 featuring "Grip-Lock" custom chuck jaws and special holding devices—soft-blank chuck jaws; adjusting blocks; coolant posts; and special bushings, collars, and tooling.

Circle **Item 529** on Inquiry Card

Heavy-Duty Lathes

R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Bulletin No. HD-1016 describing the NE design 20-hp heavy-duty lathes, which are available in four sizes providing from 17 1/2- to 25-inch swing over the beds. Twenty-seven spindle speeds are offered.

Circle **Item 530** on Inquiry Card

Sine Vee

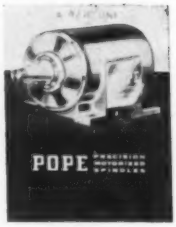
Production Tool & Die Co., Inc., Springfield, Mass. Brochure featuring a description of the toolmakers' "Sine V," which is specifically designed to reduce setup time and insure accuracy for the angular milling, grinding, and boring of round stock.

Circle **Item 531** on Inquiry Card

Axle Lathes

Farrel-Birmingham Co., Inc., Rochester, N. Y. Bulletin 3001-A on Farrel-Sellers dual-end drive journal-truing and axle lathes. Included are details describing the design and operating features, optional equipment, and machine specifications.

Circle **Item 532** on Inquiry Card



Motorized Spindles

Pope Machinery Corporation, Haverhill, Mass. Bulletin S-23 giving specifications on precision motorized spindles having a vibration amplitude of 0.000025 inch and maximum shaft run-out of only 0.000075 inch. They are available from 1 to 20 hp.

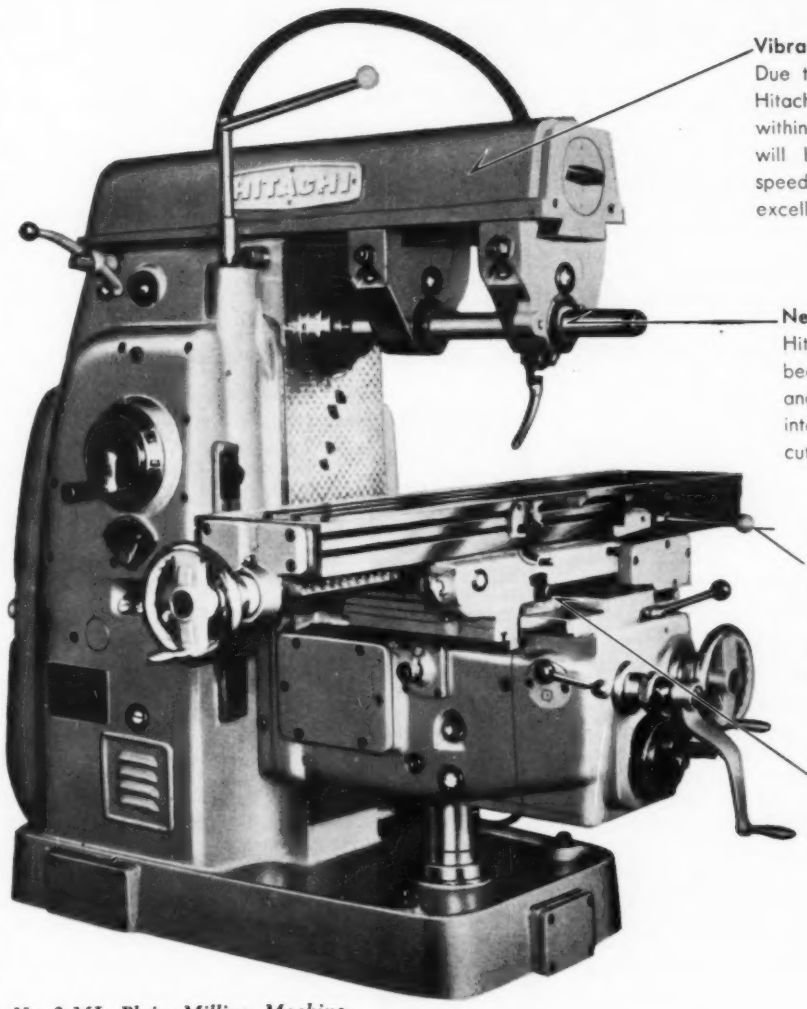
Circle **Item 533** on Inquiry Card

Gear-Production Equipment

Michigan Tool Co., Detroit, Mich. Data sheet on gears and splines showing the best processing method for each. Featured are twenty-six basic types of gear cutting, grinding, and finishing machines; gear checking equipment; and gear cutters.

Circle **Item 534** on Inquiry Card

HITACHI
NO. 2 ML MILLING MACHINES



No. 2 ML Plain Milling Machine

Vibration Damping Device
Due to a vibration damping device of Hitachi's exclusive design contained within the over-arm, minimum vibration will be set up even during higher speeds and feeds operation, so that an excellent finished surface is obtained.

New-Type Arbor Support Bearing
Hitachi's unique super precision-type bearing, a combination of plain metal and needle bearing, is incorporated into the machine to enable high speed cutting with high precision results.

Mono-Lever Control System
Hitachi's unique Mono-lever Control System makes the operation simple and easy. Table-feeding too can be performed with ease.

Backlash Eliminator of Lead Screw
As the use of two independent nuts eliminates backlash on the table feed screw, smooth down-cutting can be effected.

SPECIFICATIONS :

- 53 1/8"×10 1/16" Table
- 28" Longitudinal Traverse
- 16 Table Feeds 1/16" — 78 3/4"/min.
- 16 Spindle Speeds 25 — 1,500 r.p.m.
- 7.5 h.p. Main Motor

Hitachi, Ltd.
Tokyo Japan

Cable Address : "HITACHY" TOKYO

• Yours for the asking . . . use postcard inside back cover

Springs

Associated Spring Corporation, Bristol, Conn. Manual giving engineers and purchasing executives information needed to specify custom-designed and standardized precision springs. Helical springs, flat springs, wire forms, etc., are covered.

Circle **Item 535** on Inquiry Card

Electroplating

Hanson-Van Winkle-Munning Co., Matawan, N. J. Bulletin EP-103 giving details on nineteen plating and other metal-finishing processes. Solution preparation, type of deposits, operating conditions, equipment required, and applications are listed.

Circle **Item 536** on Inquiry Card

Cutters and Reamers

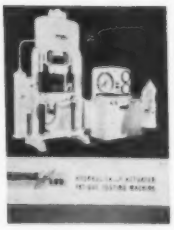
Special Cutter & Tool Co., Ecorse, Mich. Brochure on high-speed precision cutting tools. Featured are taper, ball-nose taper, multiple-step, shell, expansion, line, and semiline reamers and keyway, interlocking milling, and ball-nose rose cutters.

Circle **Item 537** on Inquiry Card

Stainless Steel

Hoeganaes Sponge Iron Corporation, Riverton, N. J. Catalogue (Form No. 128) presenting typical data on prealloyed stainless-steel and high-alloy powders. Also detailed are properties of Hoeganaes prealloyed powders available from regular production.

Circle **Item 538** on Inquiry Card



Fatigue-Testing Machines

Riehle Testing Machines Division, American Machine & Metals, Inc., East Moline, Ill. Bulletin RF-2-61 on Riehle-Los hydraulically actuated fatigue-testing machines, which are for testing material specimens and complete structural components, etc.

Circle **Item 539** on Inquiry Card

Clamping Unit

Morton Machine Works, Millersburg, Pa. Brochure introducing the company's "Jig Nut," a timesaving cam-activated clamping unit that can be applied to any clamp stud or T-slot bolt. It is claimed to have up to 5000-pound locking pressure.

Circle **Item 540** on Inquiry Card

Milling Machines

Cincinnati Milling Machine Co., Cincinnati, Ohio. Catalogue No. M-2134 featuring the company's high-power and dual-power dial type milling machines. The Dynapoise rectangular overarm and Synchro-Mesh speed change-gears are described.

Circle **Item 541** on Inquiry Card

Program Milling

Marac Machine Corporation, White Plains, N. Y. Catalogue providing information on some practical applications in the field of program milling, using Fritz Werner standard milling machines and control units. Various work-pieces are illustrated.

Circle **Item 542** on Inquiry Card

Gages

Pipe Machinery Co., Wickliffe, Ohio. Catalogue No. 11 covering special, cylindrical, thread plug, threading, titanium, pipe, Correlchek, and oil-country and API gages. Also described are thread-measuring wires and a drunken-thread checker.

Circle **Item 543** on Inquiry Card

Cutoff Machine

Rockwell Mfg. Co., Delta Power Tool Division, Pittsburgh, Pa. Bulletin containing data on the Delta 12-inch cutoff machine. Described are the four types available—dry-abrasive cutting, wet-abrasive cutting, nonferrous cutting, and wood-cutting.

Circle **Item 544** on Inquiry Card

Multiple-Operation Machine

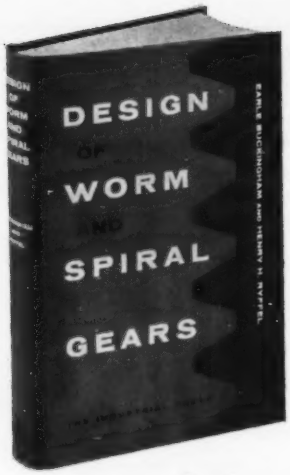
Globe Tapping Machine Co., Bridgeport, Conn. Catalogue giving details on the company's line of automatic multiple-spindle high-production machines for drilling, tapping, reaming, facing, counterboring, screw assembly, and related operations.

Circle **Item 545** on Inquiry Card

Special Coatings

S. C. Johnson & Son, Inc., Racine, Wis. Folder containing information on eighteen special industrial coatings for all types of metal-using industries. Uses include: product protection, improvement of appearance, mold or die release, and dry lubrication.

Circle **Item 546** on Inquiry Card



New!

DESIGN OF WORM AND SPIRAL GEARS

by Earle Buckingham, *Professor Emeritus, Massachusetts Institute of Technology; Gear Consultant*
and
Henry H. Ryffel, *Gear Consultant, Superior Manufacturing & Instrument Corp.; Associate Editor, MACHINERY's HANDBOOK*

Answers Questions Like These

HOW DO YOU . . .

- design fine-pitch worms for indexing?
- design worm and spur gear drives?
- design spiral and worm drives with shafts at less than 90 degrees?
- design critical worm gear drives?
- calculate acceleration and dynamic loads?
- determine radiation of heat and oil cooling?
- determine mechanical efficiency of spiral and worm drives?
- replace spiral gears with a worm drive?
- use diametral pitch worms for high speed and small reduction ratios?
- design housings?
- mount worms and worm gears?
- design built-up worm gear blanks?
- use small screw threads as worms?

WHAT IS KNOWN ABOUT . . .

- the effect of all-recess action on coefficient of friction?
- the use of torsion bars to reduce dynamic loads?
- lubrication, friction, and wear?
- influence of position of pitch plane on contact between worm and gear?
- the misuse of the hunting tooth?
- relation of pitch surface forms to axes of gears?
- influence of misalignment on the forms of pitch surfaces?

WHAT IS THE NATURE OF . . .

- contact conditions of spiral gears?
- contact on enveloping worms?
- conjugate gear tooth action on worm drives?
- load distribution across the face of worm gears?
- limits of conjugate gear tooth action?
- axial thread forms produced by different methods of cutting?
- effect of pressure angle on contact of worm gears?
- effect of lead angle on contact worm gears?
- effect of diameter on contact of worm gears?

WHAT PROCEDURES ARE USED TO . . .

- design a complete spiral gear drive?
- design a complete worm gear drive?
- make an analysis of bearing loads for spiral and worm gear drives?
- make a graphical contact analysis?
- make an analytical contact analysis?
- determine the line of zero pressure angle?
- design for specified center distances?
- develop a practical series of speed-reducing worm drives?
- design step-up drives?
- design spiral gears by geometric similarity?
- determine center distances for all-recess action?

---------- ORDER FORM ----------

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N.Y.

YES! Rush me ..... copies of "DESIGN OF WORM AND SPIRAL GEARS" @ $15.00. ☐ Check or money order enclosed. Send book postpaid.

☐ I will send payment plus 15¢ if I keep the book.
☐ Bill Company
☐ Bill me Orders from outside US—except Canada—add 50¢

Name .....
Company ..... NO. & ST. .....
City ..... Zone ..... State .....

0231

• Yours for the asking . . . use postcard inside back cover

MACHINE TOOLS

Cincinnati Filmatic plain and roll **GRINDING MACHINES** in heavy-duty sizes. For catalog G-709-1 by Cincinnati Milling circle 6-7

To obtain catalog G-60 which describes complete line of the Versatile Verson **PRESSES** circle 24

Ground finishes to 2 microns. Flatness to 1 light band. For details send for "The Art of Blanchard **SURFACE GRINDING**" by Blanchard Machine. To obtain circle 38

New illustrated booklet on Monarch Machine #62 **LATHE.** To obtain circle 42

Complete details on Marvel Saws #81A all Hydraulic Heavy Duty Automatic bar feed **BAND SAW.** To obtain circle . 54

Steelweld free booklet #2024 on mechanical and hydraulic **PRESS BRAKES,** overall bed and ram length 20'-0', 650-ton capacity. To obtain circle 60

For more information on National Broach & Machine's Red Ring **GEAR ROLLING FIXTURES** booklet C 60-8 circle .. 65

To obtain additional information on Micromatics' **HONING EQUIPMENT** Main Bearing bores held within .0003", roundness within .0001" and alignment .0002" throughout a length of 24 3/8" circle 166-167

For booklet #54 on Niagara OBI **PRESSES** with shift diameter from 2 1/2 to 4"—capacities from 22 to 60 tons circle 169

Grieder Industries booklet on new automatic loading and feeding for tube **CUT OFF MACHINES.** To obtain circle . 208

Catalog of L & J Press line of 14-150 ton O.B.I., 20-150 ton Straight Side and 30 to 75 ton Gap Frame Presses. To obtain circle 211

Avey bulletin 857 on **DRILLING MACHINES.** Capacity to 3/8-eight spindle speeds with 10.1 range, 12 swings. To obtain circle 213

Illustrated booklet on automatic **CHUCKERS** 7-spindle and 4-spindle tool rotating chucking machines by Goss & DeLeeuw. Circle 215

For additional information on the Beatty line of **BEAM PUNCHES** and Beatty line of **SPACING TABLES** circle 225

Literature available on **KEYSEATERS** featuring Davis Keyseater Co. multiple tooth cutter principle. To obtain circle 233A

W. F. & John Barnes engineers are ready to work with you to improve **PRODUCTION** methods and cut **MACHINING** costs. For descriptive literature circle 816

New Sundstrand bulletin #6281 describes their new line of 4-way convertible **BROACHING MACHINES.** To obtain circle 819

Sundstrand bulletin No. 628-2 describing their complete line of **MILLING MACHINES.** To obtain circle 820

For your copy of Greenlee Bros. catalog A-405 on their **AUTOMATIC BAR MACHINES** circle 821

MISCELLANEOUS

Catalogs and bulletins by Ex-Cell-O featuring their **DRILL JIG BUSHINGS** and other jigs and fixtures. To obtain circle 25

New Armstrong general catalog #700 showing their complete line plus approximately 330 new **TOOLS** never included in previous Armstrong catalogs. To obtain circle 28

Universal **DRILL BUSHINGS** super finished bores, all standard sizes. For catalog showing complete line circle ... 53

Catalog WPL by O. S. Walker shows complete line of this company's demagnetizers, magnetic and vacuum **CHUCKS.** To obtain circle 86

To obtain the Laminated Shim Co.'s new **STAMPINGS** folder #4 circle 88

Illustrated booklet "Cleartex in Automatic Screw Machines" by Texaco shows advantage of their 3-purpose **OIL.** To obtain circle 164

For catalog on Buck Power **CHUCKS,** aluminum body, guaranteed precision within .001 circle 210

New Oakite **CLEANER** sprays off soils, metal chips, etc. For Bulletin 9651 circle 218

UNIT PARTS

36-page illustrated booklet on Cleveland Worm & Gear **SPEED REDUCERS.** Circle 40

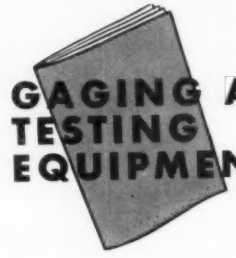
For detailed information on the Logansport Machine Co.'s line of air and hydraulic operated **CYLINDERS** and **VALVES** use coupon on page 64

For information on the new line of Allen-Bradley **STARTERS** circle 67-68

For descriptive literature on C. A. Norgren Co.'s line of **AIR FILTERS, PRESSURE REGULATORS** and **LUBRICATOR UNITS** circle 85

To obtain information on Cincinnati Custom **GEARS,** made in all types—72" diameter cut teeth, 39" shaved teeth, 25" ground teeth circle 179

All types of **CAMS** made to your specifications by Eisler Engineering Co. Catalog can be obtained by circling .. 231B



GAGING AND TESTING EQUIPMENT

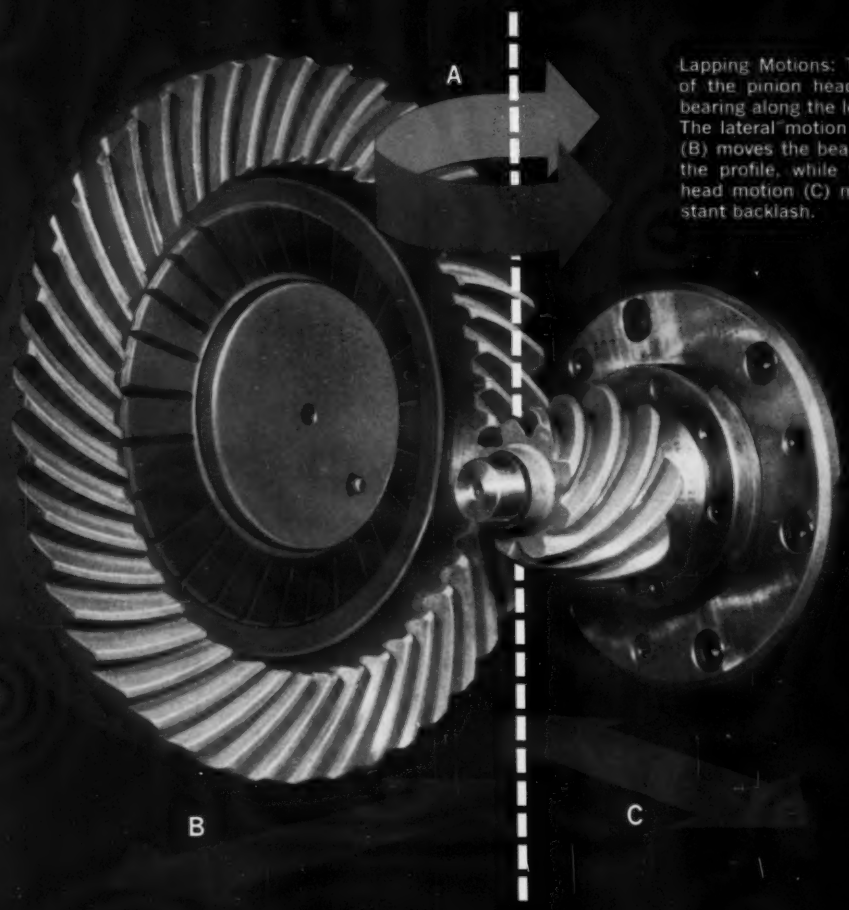
For catalog on complete line of Sheffield Corporation's **GAGES AND ACCESSORIES** circle 177

Bulletin 2956 featuring a portable device for maintenance, fitting and testing of **DIES** by Hamilton Tool. To obtain circle 209

Zagar's new booklet shows their line of **FIXTURES** for drilling grinding, milling, etc. To obtain circle 227A

Additional literature on Briney Mfg. Precision **ADJUSTING TOOLS,** pre-loaded bearings-split tenth adjustments. To obtain cricle 227C

Comtor Co. booklet 51 on expanding **PLUG GAGE** for holes 1/8" to 10" diameter fixed reading—2 point gaging. To obtain circle 231D



Lapping Motions: The swing motion of the pinion head (A) sweeps the bearing along the length of the tooth. The lateral motion of the gear head (B) moves the bearing up and down the profile, while the lateral pinion head motion (C) maintains the constant backlash.

New "Swing Pinion Cone" motions lap gears to 26" diameter automatically

Several design innovations in the new Gleason No. 504 Lapper combine to offer you a *more flexible* machine, *more accurate* results; a machine that will give you *more consistent* gear sets.

The new *SPC** motions allow a more rigid design—and the gear tooth surface responds more quickly and more consistently than to the previous types of lapping motions. Production rates are substantially increased.

The swinging motion of the pinion head sweeps the tooth bearing area along the length of the tooth, while horizontal motions of both heads move the bearing up and down the tooth profile, while maintaining uniform backlash.

Servo Controls provide for simpler setup and operation, and further contribute to increased speed and accuracy. All lapping motions are established by simple dial settings. This electrical control is positive and fast acting.

You can lap hardened spiral bevel and hypoid gears with 90° shaft angles, and conventional gears with shaft angles from 50° to 110°. Add an angle plate for the pinion head and you extend the work range from 10° to 160°.

An optional variable speed drive motor permits spindle lapping speeds from 200 to 2000 RPM.

No cams or special parts are required from job to job other than arbor equipment.

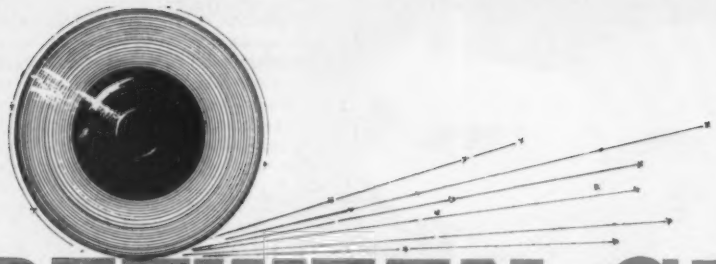
For more information and specs, write us. We'll be glad to send full details promptly.

*SPC means "Swing Pinion Cone."

No. 504 Hypoid Lapper

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N. Y.



By E. S. Salichs

BETWEEN GRINDS

Apaches on the Ore Path!

The Wild West is now the scene of a new rush, according to *Steelways*—one for iron ore. The magazine disclosed that ore prospectors of one company are now concentrated at Cibecue, Ariz., deep in the White Mountain Apache Indian Reservation, where the Bureau of Mines estimated the existence of at least 10,000,000 tons of ore. Pow, more chow.

Moon Dust

An automated "moon drill" operated from unmanned spacecraft is now being developed by a design team at Armour Research Foundation, according to *Industrial Research Newsletter*. The moon drill will penetrate the lunar surface and retain samples of both rock and dust. The team may be startled if such items as vodka labels or caviar jar tops turn up.

Quick Fix for Pix

An attachment for aerial cameras was recently introduced by Chicago Aerial Industries, Inc., which uses a single solution containing the developer and fixer, permitting the negative to be ready two minutes after the last picture is taken—and the film cannot be overdeveloped or underdeveloped. Personally, this feature interests us, since our pictures are, in turn, either one or the other.

Cosy Clothing

Electrically heated socks, gloves, and shoes are being tried out by the British War Department. But how can you tell when the heat is on?

Sea-Saw

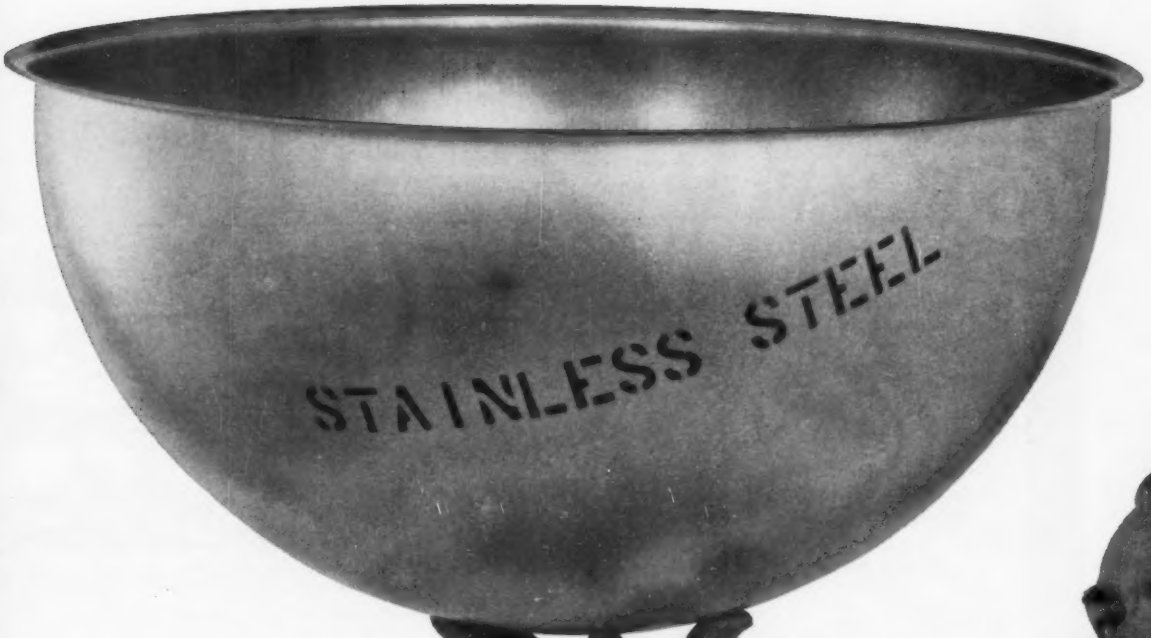
An underwater horizontal metal-cutting band saw was recently constructed (for special use by the United States Government) by W. F. Wells & Sons, Inc. Fortunately, it will be operated by remote control from the surface.

CLUTCHING HANDS, NEW STYLE—Mobot Mark II was created by the Hughes Aircraft Co., Los Angeles, Calif., as a substitute for human beings in areas too dangerous for them to work in. It has double-jointed shoulders, elbows, and wrists; soft-padded hands—flexible enough to replace a light bulb, for example; and TV camera eyes to transmit pictures of its handiwork to a human operator at a remote-control console. Despite all this versatility, we'll still take the model!

This 22" dia. hemisphere

is stainless steel

.010" thin



Hydroformed by
The Jones Metal Products Co.,
West Lafayette, Ohio

formed with less than

.001" thin-out

in 1 draw on a 32"

CINCINNATI® Hydroform®

Hydroforming precision deep drawing benefits include improved part finish and quality, fewer operations, tool cost savings as high as 90%, and material cost savings as much as 50%. To determine your savings by Hydroforming, write for information or call in a Meta-Dynamics application engineer.

META-DYNAMICS DIVISION

Center of Chipless Metalworking
Hydroform • Intraform • Hydrospin

CINCINNATI

THE CINCINNATI MILLING MACHINE CO.
Cincinnati 9, Ohio

GLX-W COLUMBIUM-TREATED CARBON STEEL CUTS DEAD WEIGHT 10% IN NEW

VERSATILITY...
That's the Beauty of Steel

Bringing important new economies to rail shipment of automobiles, this new tri-level auto carrier holds twelve standard cars or mixed loads of 14 standards and compacts. Capacity is increased up to 75%. A unique system of hydraulically positioning the vehicles on three levels gives a clearance of only 16 feet 8 inches, permits use in areas formerly limited to bi-level unit operation because of clearance requirements. ◆ Key feature of the Multi-Car Carrier is the movable decks on which the cars ride. Made of GLX-W columbium-treated steel, the decks are raised and lowered by built-in hydraulic lifts, actuated by a portable power unit. Here light weight was essential, in order to reduce the operating power requirements. Yet great strength was necessary, too, to support the payload. Finally, design of the decks called for eight bends in each section. So formability was also a must. ◆ GLX-W met and exceeded all these requirements. It gives 50-100% greater strength than mild carbon steel, so builder Whitehead and Kales could get the required strength with less weight. Deck operating units need less power,

Great Lakes Steel is a Division of

Multi-Car Carrier built by Whitehead and Kales for Multi-Car Corporation, Detroit, Michigan

TRI-LEVEL AUTO CARRIER

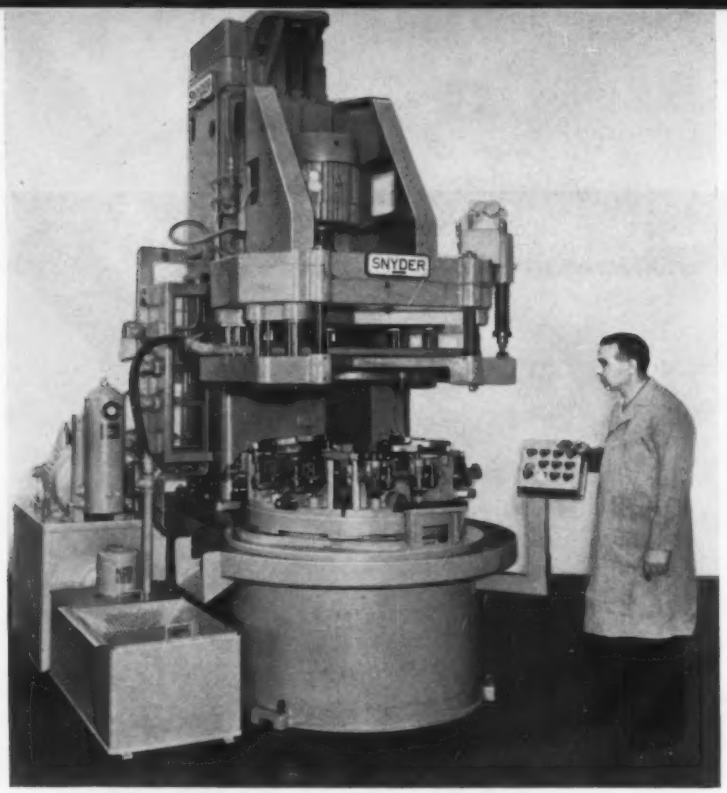
and total weight is reduced approximately 5,000 pounds or 10%. Production is more economical, too, because the ductility and formability of GLX-W permits four of the bends in the deck to be performed in one press operation. ◆ The GLX-W series of high-strength steels consists of fine-grained, semi-killed mild carbon steels, treated with varying amounts of columbium. The high strength of GLX-W permits designers to reduce the amount of steel and effect considerable cost savings when replacing mild carbon steel. GLX-W steels have a low carbon content and are readily weldable and formable. GLX-W steels are available at four minimum yield strength levels: 45,000, 50,000, 55,000 and 60,000 p.s.i. and in sheets, plates and bars. For complete technical information, write Great Lakes Steel Corporation, Product Development, Dept. M-9, P. O. Box 7310, Detroit 2, Michigan.

A PRODUCT OF

GREAT LAKES STEEL

Detroit 2, Michigan

NATIONAL STEEL CORPORATION



Snyder special rotary index machine that drills, countersinks, and reams automotive door hinges at a rate of 652 pieces per hour

Rotary Index Machine for Processing Automotive Door Hinges

A special six-station rotary index type machine that drills, countersinks, and reams a variety of malleable-iron automotive door hinges at a rate of 652 parts per hour at 100 per cent efficiency has been built by the Snyder Corporation, Detroit, Mich. A left-hand hinge and a right-hand hinge are clamped in each work-fixture so that a pair of finished hinges is produced at each indexing movement. A unique feature of the machine is a motorized two-spindle drilling unit mounted underneath the rotary work-table on the side of the machine base at Station 5. This unit countersinks a hole in the bottom of the hinges. The countersinking tool passes through a bushing on which the hinge rests. This feature increases the versatility of a rotary index machine which normally provides machining operations for only one side of a part.

One set of hinges that is processed on the machine has a through hole that is drilled, countersunk on both ends, and reamed; and another blind hole that is drilled and countersunk. The other pair of hinges that are processed have a through hole that is drilled, countersunk on both ends, and reamed. Change-over from one part to another is accomplished by removing the tools for the blind hole when the part with the single hole is to be machined.

This special rotary index machine is hydraulically operated and electrically controlled. It is made up of Snyder standard components, including the machine column, slide unit, index-table, index mechanism, and coolant tank. A sixteen-spindle drill head is mounted on the standard way type vertical slide unit. Hydraulic power for operating the machine is supplied by a separate motorized pump and tank unit. The machine occupies a floor space approximately 7 feet wide by 9 feet deep and is 11 1/2 feet in height.

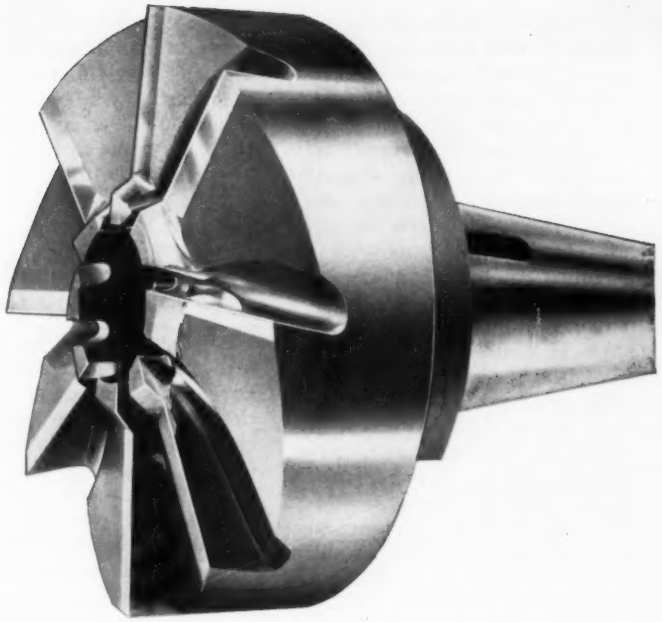
Circle 598 on Readers' Service Card

Sheffield Crushtrue "Multi-Form" Grinder for Rod-Mill Rolls

The Sheffield Corporation, subsidiary of Bendix Corporation, Dayton, Ohio, has received orders from the American Steel & Wire Division of United States Steel Corporation and the Bethle-

Crushtrue wheel grinding several grooves simultaneously on a small rod-mill roll, using a modified Sheffield No. 181 Multi-Form grinder similar to the larger Model 190 machines to be built for the American Steel & Wire Division, United States Steel Corporation, and the Bethlehem Steel Co.

RETURN
ON YOUR MACHINE
INVESTMENT
DEPENDS ON THE
CUTTER YOU USE
HERE



Illinite® Job-Tailored Milling Cutters do more work . . . cut costs

The more a milling machine and operator time costs, the more important the right milling cutter becomes. Upon it rests the responsibility not only of output, but profits.

That's why so many major manufacturers with heavy investment in production equipment are turning to Illinite Job-Tailored Milling Cutters after a cost analysis review of their (present or planned) production milling operations.

Illinois Tool Works' nearly 50 years of specialization in job-tailored production tool engineering—with emphasis on design, forging, heat treating and material selection—brings these cost cutting benefits to you.

The new ITW guide to Milling Cutter application evaluation and cost analysis will help you plan optimum production milling programs. See how this analysis, along with helpful hints to better milling, can improve your operation. Get your copy now; you'll be glad you did.

Send for your copy

This cutting tool performance evaluation form helps you quickly set down the facts concerning your production milling application. Whenever possible make this analysis before expensive production begins. Your ITW representative will help you.

ILLINOIS TOOL WORKS
TOOL & INSTRUMENT DIVISION
2501 N. Keeler Avenue • Chicago 39, Illinois
In Canada: CITCO DIVISION, CANADA ILLINOIS TOOLS, Ltd.
Don Mills, Ontario

hem Steel Co. to design and build industry's first machines to grind "passes" (circular grooves) in rod-mill rolls instead of turning them on lathes, which is the current practice. Grinding rod-mill rolls permits the use of rolls of harder metal than can be turned on a lathe. The harder rolls have the advantage that more tonnage can be rolled before the grooves wear oversize.

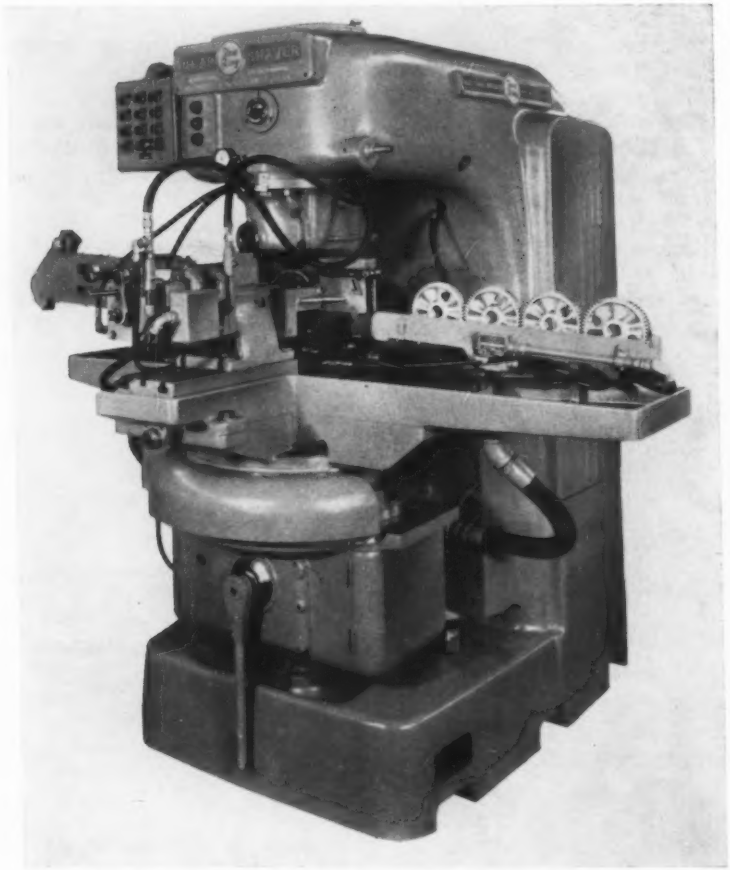
During the past two years, Sheffield Crushtrue ground rolls have been used in a number of mills throughout the country. Users report that pass life in the harder ground rolls is as much as 250 per cent longer than that obtained with the hardest turned rolls. In addition, grinding the grooves instead of turning them is said to have resulted in time savings of up to 98 per cent.

The new machine, designated Model 190 Crushtrue "Multi-Form" grinder, will handle rolls up to 6 feet long and 14 inches in diameter, weighing up to 3000 pounds. It will use a grinding wheel 30 inches in diameter by 10 inches wide, Crushtrue-dressed to permit multiple grooves or passes to be ground in the roll simultaneously. The machine will grind the grooves on new rolls directly from the solid, as well as regrind the grooves in worn rolls.

Circle 599 on Readers' Service Card

Red Ring In-Line Automatic Loader for Gear-Shaving Machine

An in-line Red Ring automatic loader that permits a straight-line flow of gears through a conventional rotary gear-shaving machine has been developed and put on the market by the National Broach & Machine Co., Detroit, Mich. This equipment makes available a second method of automatically processing gears through a shaving machine on automated lines. The conventional Red Ring method infeeds and returns shaved gears at the front of the machine. The new in-line method feeds gears in a straight line across the machine, or through a battery of machines. This new method of feeding also permits automatic handling of larger-diameter gears than was previously possible in a shaving machine of equivalent size.



Red Ring in-line automatic loader installed on a Red Ring Model GCU rotary gear-shaving machine

The new in-line loader is a slide type that is operated by two air cylinders. One air cylinder moves the slide back and forth, while another raises and lowers two jaws on the slide through a linkage mechanism. In operation, the gears to be shaved are first rolled between a pair of gaging gears mounted at the entrance end of the magazine. Oversized gears are thus prevented from entering the magazine, and the shaving cutter is protected from damage. In the magazine the gears roll by gravity into a position in front of the shaving cutter. A gear is picked up automatically by one of the jaws on the slide and placed in the shaving position while the other jaw on the slide places a finished shaved gear in the exit chute. The gear is then chucked by the air-powered tailstocks, the jaws lower, and the slide returns to the starting position. At the end of the automatic shaving cycle, the tailstocks release the shaved gear and it is picked up by the exit feed jaw.

In-line types of automatic loaders can be provided for all sizes of Red Ring Models GCU 8-inch, GCU 12-inch, and GCU 18-inch rotary gear-shaving machines. The magazine, exit chute, jaw details, and tailstock clamping means are designed to suit the specific gears to be shaved.

Circle 600 on Readers' Service Card

(*This section continued on page 203*)

here's the one SOLUBLE CUTTING LUBRICANT that WON'T GO RANCID

and it's backed by an UNQUALIFIED GUARANTEE

We absolutely GUARANTEE that MACCO 472 MPA will not turn rancid under any circumstances. We are the only manufacturer of soluble cutting lubricants who can make this Guarantee.

IT'S MACCO 472 MPA*

Ideal for MACHINING ALL METALS ON ALL TYPES OF EQUIPMENT

THERE'S NOTHING ELSE LIKE IT!

Hard to believe? You bet! But, it's a fact—backed by experience. One plant with hundreds of machines down 70 days, another 116 days, still another for 6 months (names will be furnished on request) —all started up with the same MACCO 472 MPA solution that was in use when they shut down, and ABSOLUTELY NO TRACE OF RANCIDITY IN ANY MACHINE!

With vacation shutdowns coming now is the time to make the change to MACCO 472 MPA. Save yourself a lot of headaches, and some hard earned maintenance dollars to boot. Write or Phone Today for a Macco engineer. He'll give you facts, and make it possible for you to prove for yourself why MACCO 472 MPA is today's No. 1 soluble cutting lubricant in plant after plant. When vacation is over you'll start up with no worry . . . NO RANCIDITY!

And, in addition, **WE GUARANTEE TO INCREASE YOUR TOOL LIFE 25%, or more!**

***An Exclusive Development**

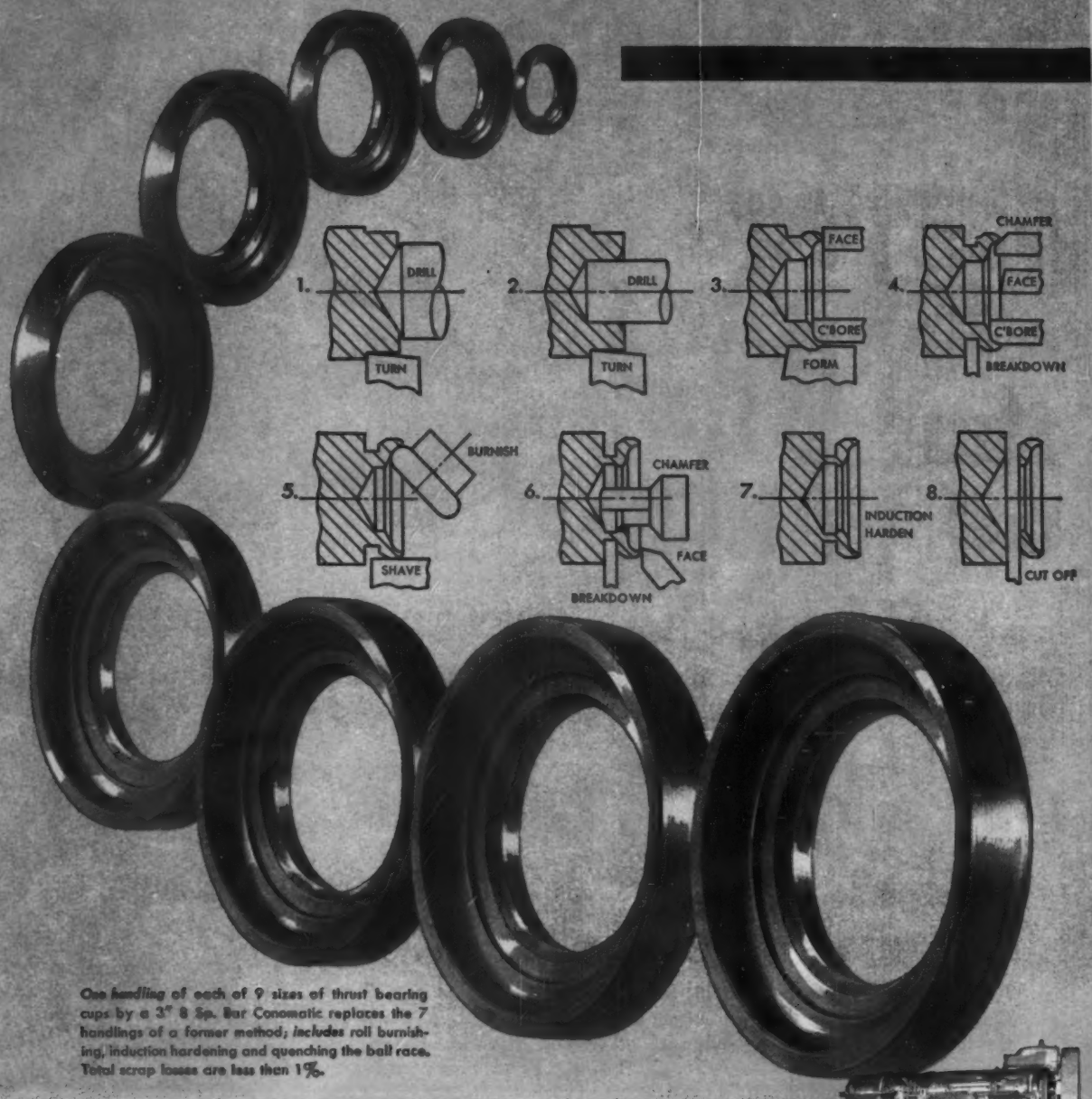
472 MPA is one more of many reasons why
THE METALWORKING INDUSTRY LOOKS TO MACCO FOR LEADERSHIP

CLEANING COMPOUNDS
CUTTING LUBRICANTS

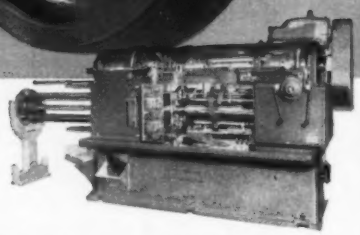
DRAWING COMPOUNDS
RUST PREVENTIVES
FORGING COMPOUNDS
EXTRUSION LUBRICANTS

MACCO
PRODUCTS COMPANY
CHEMICAL COMPOUNDS FOR THE METALWORKING TRADE SINCE 1921

9202 mc S. SANGAMON ST., CHICAGO 20, ILLINOIS
PRESCOTT 9-0800



One handling of each of 9 sizes of thrust bearing cups by a 3" 8 Sp. Bar Conomatic replaces the 7 handlings of a former method; includes roll burnishing, induction hardening and quenching the ball race. Total scrap losses are less than 1%.



Those cost-saving EIGHTS!

With more work spindles and tooling positions for including — in one chucking — operations that would otherwise require the expense of second handling, you just can't *beat* THOSE COST-SAVING EIGHTS.

Likewise, as replacements of four spindle machines — on more simple work — with double stock feed and double setup, producing two pieces per cycle, nothing *compares* with THOSE COST-SAVING EIGHTS.

For ever-increasing work requirements — in less floor space, with less power, less coolant, less lubricant and maintenance, and less transfer and paper work — many "automatic" users are finding THOSE COST-SAVING EIGHTS more *profitable*. How about *you*?

Write, wire, or phone *today* for particulars. There is no obligation. Cone Automatic Machine Company, Inc., P.O. Box 27, Windsor, Vermont.

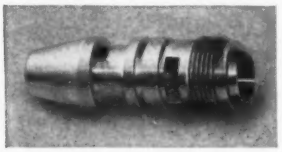
Conomatic

World's Most Productive Line of Automatic Lathes

Consistent, *dependable* handling of one or more of the following operations in a single setup has earned the CONOMATIC an enviable reputation as the *leader* of THOSE COST-SAVING EIGHTS: cross drilling and milling, end milling, broaching, spinning, stamping, OD and ID burnishing, eccentric drilling, turning and boring, eccentric forming, multiple hole drilling and tapping, oil groove rolling, back facing, back slotting, back hole drilling and counterboring, induction hardening and quenching.

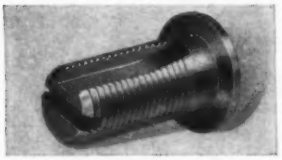
One handling of this SAE 1113 stud by a 1⅝" 8 Sp. Bar Conomatic *includes* rolling one OD pipe thread and cutting the other. Also *includes* cutting OD straight thread and ID pipe thread.

One handling of this Ball Joint Housing (1012 steel) by a 2⅜" 8 Sp. Bar Conomatic *includes* burnishing inner ball race.

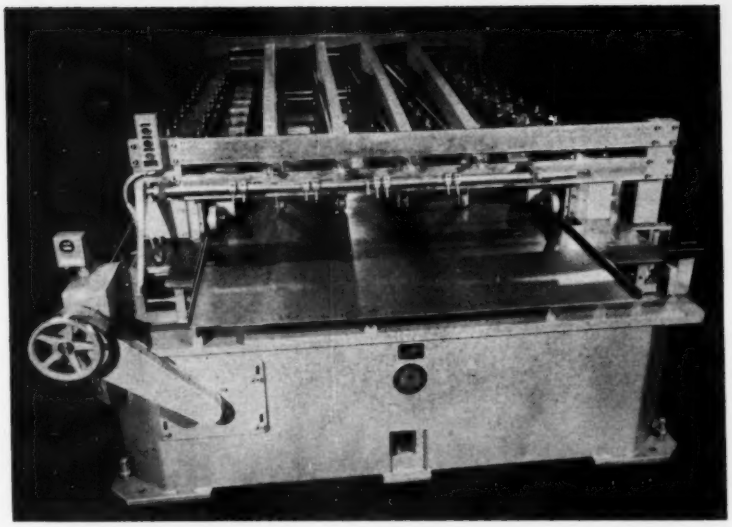


One handling of this Sleeve (B-1112 steel) on a 1⅜" 8 Sp. Bar Conomatic *includes* offset milling.

One handling of this Valve Bushing (8620 steel) by a 1" 8 Sp. Bar Conomatic *includes* cross drilling of 4 holes and back counterboring of large hole.



One handling of this Threaded Stud on a 1" 8 Sp. Bar Conomatic *includes* cross milling, slotting, thread chasing, and back facing (all operations without stopping the work spindles).



Special ten-station steel-panel forming machine made by Maplewood Division of the Rockford Machine Tool Co.

Maplewood Ten-Station Panel-Forming Machine

A model PTR 55-10 special ten-station roll-forming machine manufactured by the Maplewood Division of Rockford Machine Tool Co., Rockford, Ill., produces all-steel panels from 8 up to 66 inches in width, forming both edges in one pass, at forming speeds of 40 to 120 fpm. This machine has a motor drive to the movable head and can be changed quickly to produce panels of any size within its capacity. It is equipped with two sets of roller dies, permitting the production of two different types of panels in any of the many widths required.

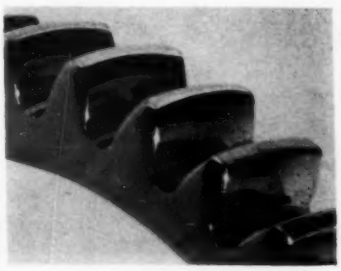
Special features of this mass-production type machine include: quick-acting sheet supports placed down the center of the machine to provide adequate support for the widest sheets, a Durant visual reading counter which shows the position of the movable head in inches and sixty-fourths of an inch, and extremely rugged construction designed to give years of efficient service at lowest overall cost.

Specifications include: direct chain drive with double power take-off; welded steel frame; steel housings; steel cut heat-treated gears; tapered and straight roller bearings; pressure type lubricating system; micrometer dial type individual upper-spindle adjustments; and 10-hp, 3-phase, 440-volt General Electric drive motor.

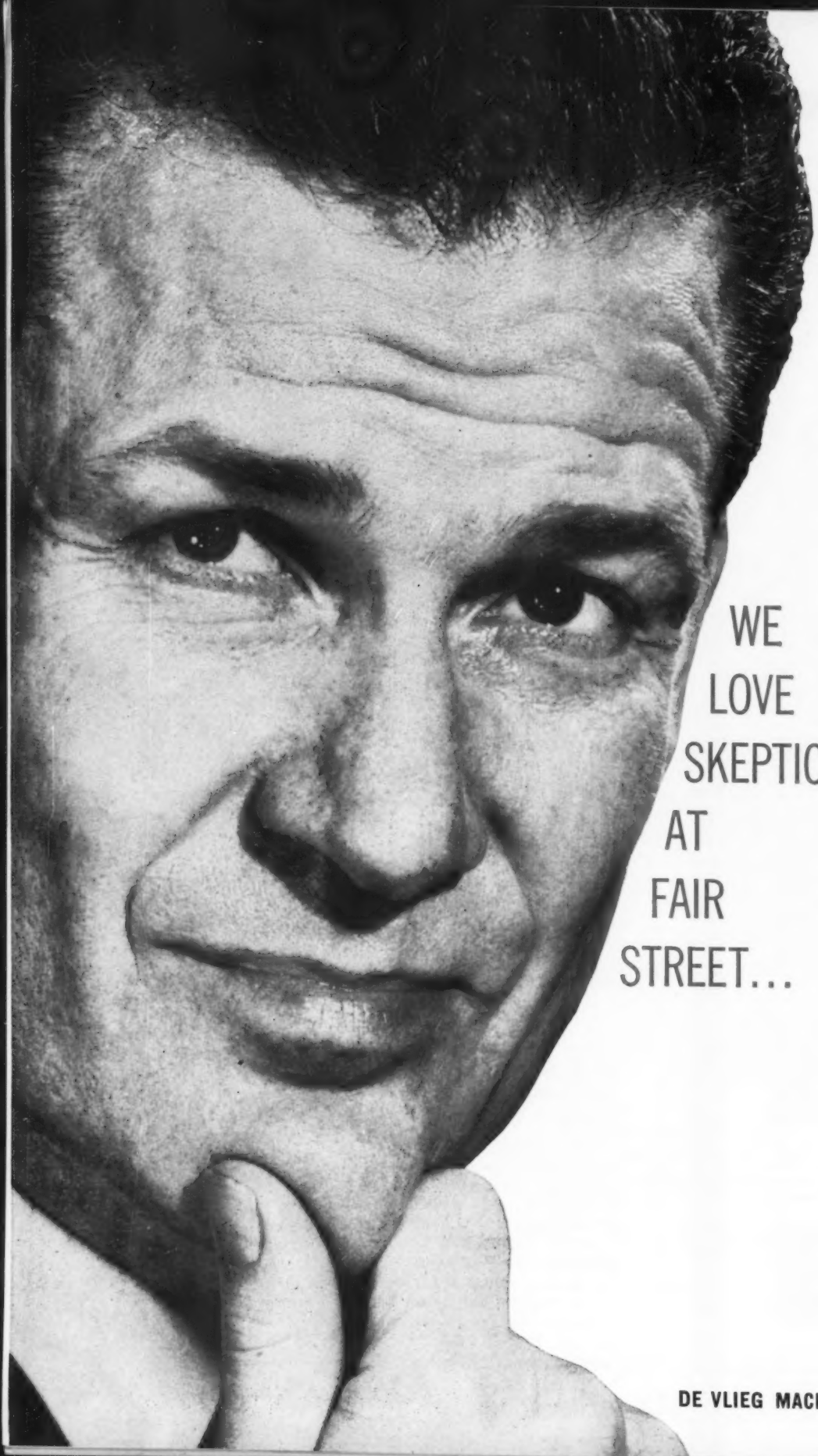
Circle 601 on Readers' Service Card

Automatic Form Grinder for Producing High-Precision Crowned Spherical Teeth

Development of an automatic external form grinder, which will produce precision crowned spherical coupling teeth by grinding, has resulted in greatly increased output at the plant of the Bell Helicopter Co., Fort Worth, Tex. The grinder developed for this job was built for Bell by the Gear Grinding Division of Michigan Tool Co., Detroit, Mich. It incorporates a rocker-arm action which



Close-up view of the spherical coupling teeth produced by a Michigan Tool Co. gear grinder at Bell Helicopter plant



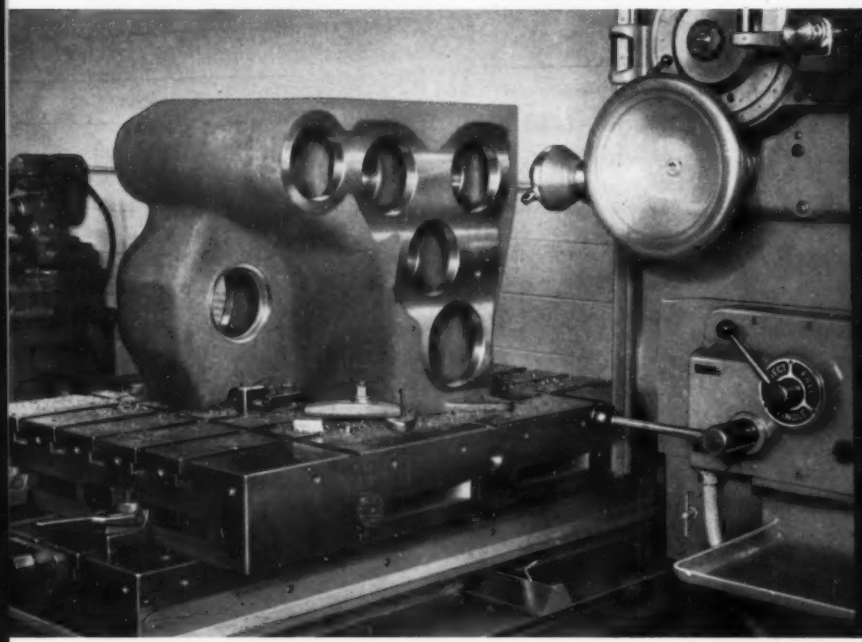
WE
LOVE
SKEPTICS
AT
FAIR
STREET...

DE VLIEG MACHINE COMPANY

Of course, everyone who comes to Fair Street for the first time is a skeptic. At least partially so. But we especially like a good healthy skeptic; the man who finds it hard to swallow all he's heard about the proficiency of our JIGMIL and the soundness of the DeVlieg Philosophy of Precision Machining.

SOME OF OUR JIGMIL USERS

AFC Industries, Inc.
Air Reduction Co., Inc.
Alliance Tool & Machine Co.
Amco Incorporated
Bendix Corp.
Besly Welles Corp.
Bethlehem Steel Co.
Burg Tool Mfg. Co.
Buhr Machine Tool Co.
Cessna Aircraft Co.
Cross Company
Farrel-Birmingham Co., Inc.
Gardner-Denver Co.
Gardner Machine Company
Goulds Pumps, Inc.
Harnischfeger Corp.
Hill Machinery Co.
Homogenette Inc.
Hoover Tool & Die Co.



DeVlieg Spiramatic JIGMIL precision bores and mills mining machine transmission housing from two sides on a 180° index.

Basic Principles in the DeVlieg Philosophy of Precision Machining

- A Machine Tool Capable of Desired Accuracies
- Correct Tool Geometry
- A Method of Tool Preparation and Maintenance

Only DeVlieg Delivers the Complete Package!

Hyster Co.
Ideal Tool & Mfg. Co.
Lake Erie Machinery Corp.
Leesona Corp.
Marion Power Shovel Co.
Mason, Shaver & Rhoades Inc.
Midwest Machine & Mfg. Co.
National Electrical Welding Machines Co.
National Mine Service Co.
New Deal Tool & Machine Co.
Paramount Boring & Machine Co.
Paul Machine Tool & Die Works
Quality Tool and Die Co.
R & B Tool Company
Rochester Products Div., GMC
Saginaw Steering Gear Div., GMC
Snyder Corp.
Standard Tool Co.
Vard Div., Royal Industries Inc.
Vogt, Henry Machine Co.

The JIGMIL is one of those things that you've got to see demonstrated to believe. Only by seeing it demonstrated will you know its complete range of capabilities. The accuracies that it routinely achieves. The ease with which it operates. How simple it is to program or control. How easy to maintain. How rugged and durable it is. If you're a good healthy skeptic, why not visit Fair Street! As we've just said, we'd love to have you. After all, some of our biggest skeptics have become our best customers.

WILL YOU BE THE NEXT TO VISIT FAIR STREET

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

FAIR STREET • ROYAL OAK, MICHIGAN

produces a spherical tooth (including the root) rather than a flat tooth shape. The rocker arm controls the grinding-wheel movement as it reciprocates through the cut.

Use of automatic down feed plus automatic wheel dressing is said to increase accuracy, as well as boost production. With this setup, spherical couplings are being held to size within 0.0004 inch on the modified involute form, tooth-to-tooth spacing within 0.0002 inch, and maximum spacing error between any two teeth within 0.0006 inch. The part is the inner coupling for the tail-rotor drive. It drives the tail-rotor blade and is designed to allow for operational deflection in the system.

Circle 602 on Readers' Service Card

Leveling Jacks for Machine Tools

The Enterprise Machine-Parts Corporation, Detroit, Mich., has announced a new series of adjustable leveling jacks, with capacities up to 20,000 pounds, for precise level installation of machine tools, automation lines, and other toolroom and production equipment. The series is designated Empco Style J-H leveling jacks.

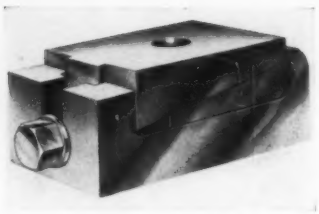


Fig. 1. Empco J-H leveling jacks

Of unusually compact design, as shown in Fig. 1, the new units permit up to 1/4-inch vertical adjustment, and feature two interacting inclined planes which give smooth upward or downward control without lateral movement. The vertical motion of the top plate, according to company engineers, eliminates shifting or imbalance caused by vibration or lateral stress on machine legs or tie-downs.

Designed for use at corners, centers, or along the entire machine base, the new J-H levelers are installed wherever equipment needs support. Anchor bolts, where required, pass through the entire jack assembly. Other standard features include a convenient hex-head adjusting screw and a self-compensating concave base, see Fig. 2, which counteracts uneveness of floor. Vibration-absorbing mounting pads are offered as optional equipment.

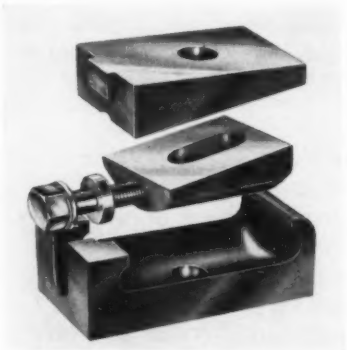
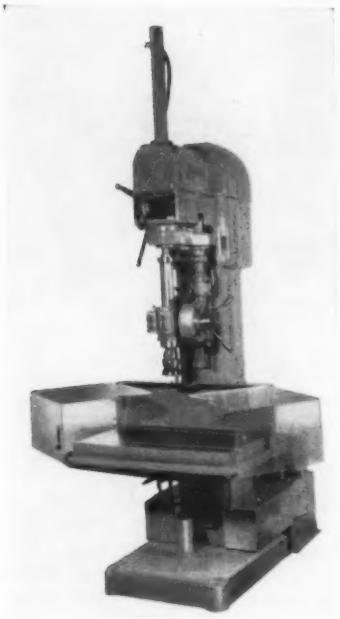


Fig. 2. Disassembled Empco jack

Circle 603 on Readers' Service Card



RPMster drilling machine

Drilling Machine for Superhard Materials

The Buffalo Forge Co., Buffalo, N. Y., is now equipping its RPMster with special hollow spindles to do drilling jobs in superhard exotic materials that were thought to be impossible just a short time ago. This machine has a variable-speed drive that permits instant speed changes while drilling. Its unique features include, in addition to the hollow spindle, a transfer attachment for introduction of coolant under pressure, variable feeds, higher speeds, and coolant pumps to deliver adequate coolant pressure.

The hollow-spindle RPMster is being used successfully to drill such superhard metals as titanium, stellite, René 41, and stainless steel. It also quickly and cleanly drills some of the hardest new ceramic materials. In actual runs, production is said to have been increased over 300 per cent. The holes produced are very close to actual drill diameters.

Readers are invited to send a sample of any hard-to-drill material direct to the Buffalo Forge Co.'s factory, where the company's engineers will conduct test drillings and return the sample together with a report on the drilling data, with no obligation.

The "Buffalo" RPMster in three sizes, as well as the No. 18 and No. 22 drilling machines, are all available with the special hollow spindle.

Circle 604 on Readers' Service Card

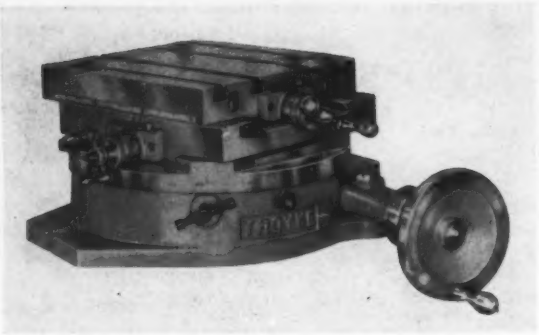
"Super Seal" Limit Switches

Virtual elimination of limit-switch failure by using epoxy resin to exclude mositure is announced by the Electrical Controls Division, National Acme Co., Cleveland, Ohio. According to the announcement, these new "Super-Seal" switches are guaranteed for at least 10 million cycles, or one year of operation. The units are rendered tamper-proof by fastening switch covers to the housings with drive screws.

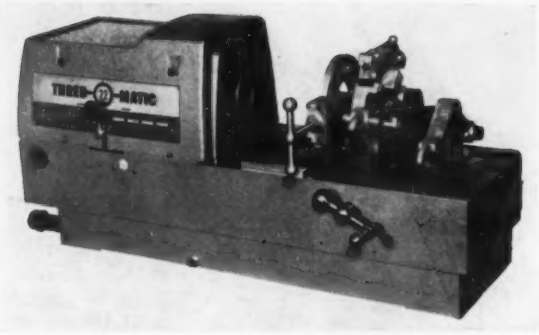
The material used to seal the switch has high dielectric strength and unusual chemical stability, including resistance to solvents. It also possesses excellent mechanical properties, including high resistance to heat and shock, unusual tensile and compression strengths, and a low shrinkage coefficient.

Circle 605 on Readers' Service Card

For more data circle this page number on card at back of book



Cross-slide rotary table brought out by Troyke Mfg. Co.



Thred-O-Matic pipe, conduit, and bolt threader

Precision Cross-Slide Rotary Table

To meet the demand for a moderate-priced precision cross-slide rotary table, the Troyke Mfg. Co., Cincinnati, Ohio, announces their new model DMT-15. This is a combination of a cross-slide and rotary table built into one rugged unit that affords precision X- and Y-axis as well as rotary positioning. This unit has a 12- by 12-inch working surface with a 10-inch travel, and features hardened and ground acme feed-screws mounted on tapered roller bearings which run in adjustable bronze nuts.

Accuracy is held to 0.001 inch in the full 10-inch cross-slide travel. Other features include: tapered, adjustable gibs; quick-set cross-slide dials graduated in 0.001-inch increments; stainless-steel scales on the cross-slides graduated in 0.100-inch increments; rotary table dial graduated in 1-minute increments; ball bearings on the worm-shaft of the rotary table; quick disengagement of the worm; and precision-ground working surfaces.

Circle 606 on Readers' Service Card

Collins Pipe, Conduit, and Bolt Threader

The Collins Machinery Corporation, Monterey Park (Los Angeles), Calif., has announced a Thred-O-Matic "22-A" pipe, conduit, and bolt threader. This machine is said to have seven major features, most of which are claimed to be exclusive on this new unit.

The machine has a totally enclosed, automatic double chuck; highest usable production speed provided by powerful, long lasting, six-brush motor; and design developed specifically for make-up or tear-down of fittings. A choice of mono, dual, or universal die-heads with built-in automatic oil flow is offered. New offset cutter on carriage for maximum visibility and accuracy in cutting is an important new feature. The positions of cutter and reamer assemblies are interchangeable. Lightness and compactness are provided by Alcoa permanent-mold castings.

The capacity range is from 1/8- to 2-inch pipe and conduit, and 1/4 to 2 inches for bolts.

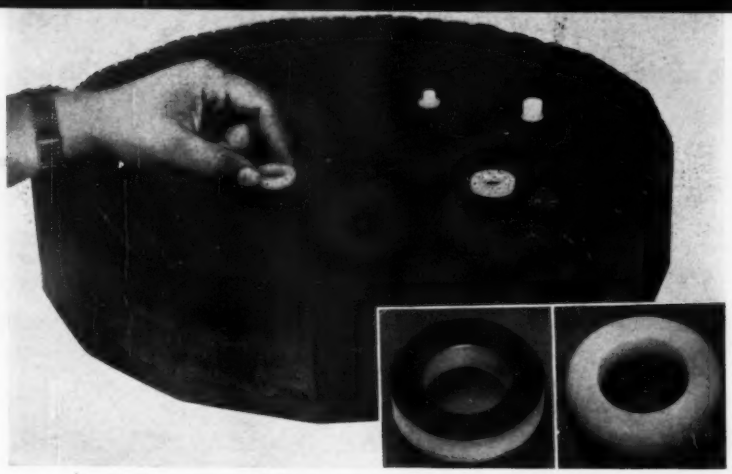
Circle 607 on Readers' Service Card

DoALL Noncontaminating Black-Granite Lapping Plate

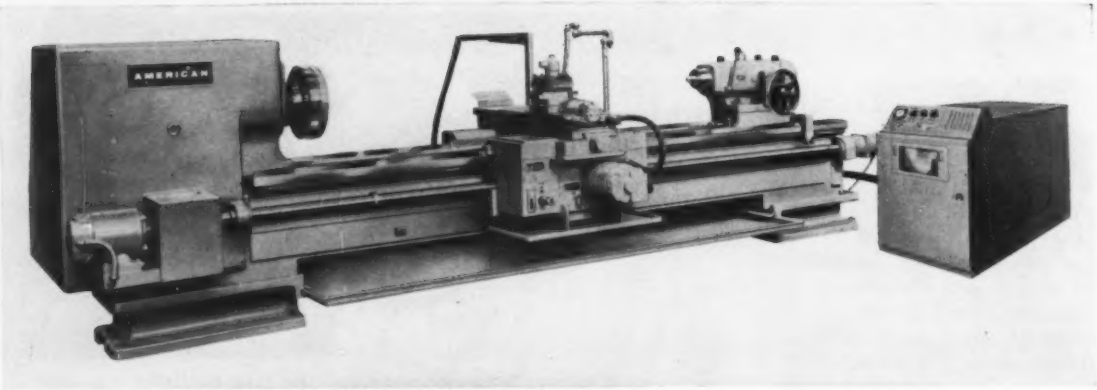
A noncontaminating hand lapping plate that produces fine finishes on Teflon, nylon, and other nonferrous materials is now available from the DoALL Co., Des Plaines, Ill. It is made from the same material used for DoALL black-granite surface plates. The new lapping plates are 12 and 18 inches in diameter and 3 inches thick. The lapping surfaces are grooved with 1/8-inch deep serrations spaced 1/2 inch apart. The advantages of this noncontaminating lapping plate are said to be threefold: finer surface finish, better appearance, and elimination of the danger of a contaminator causing malfunctioning of the lapped part.

The DoALL noncontaminating black-granite lapping plate shown in the illustration can be used to obtain fine micro-inch finishes on Teflon and nylon as well as most other plastics and nonferrous metals. In the insert are two nylon valve parts. The one on the left was lapped with cast iron and contained particles of swarf embedded in the surface, a condition that caused excessive wear of the mating part. The one on the right was lapped between black-granite plates, and its surface is completely free from foreign material.

Circle 608 on Readers' Service Card



Black-granite lapping plate available from the DoALL Co.



One of four sizes of tape-controlled engine lathes announced by the American Tool Works Co.

American Tool Works Tape-Controlled Engine Lathe Available in Four Sizes

An engine lathe designed and built for continuous-path tape control has been introduced in four sizes by the American Tool Works Co., Cincinnati, Ohio. Each lathe is controlled by a General Electric Mark Century continuous-path control system, using 1-inch, eight-channel punched tape. Newly designed from the ground up, this heavy-duty lathe is said to have tested and proved production and accuracy features. It is adapted for handling all roughing as well as finishing work on any turning, boring, and facing operations.

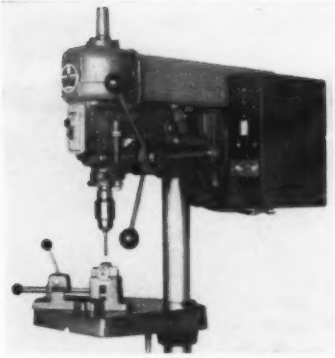
The 2010 and 2413 lathes have two-speed heads with a total speed range, in conjunction with their 16-to-1 motors, of 25 to 1800 rpm through thirty taped changes. Maximum motor size for these lathes is 30 hp.

Swing over carriage wings for the 2010 is 21 inches; and over the carriage bridge and tool-block, 10 inches. The 2413 lathe swings 24 inches over the carriage wings and 13 inches over the carriage bridge and tool-block.

Circle 609 on Readers' Service Card

Cutoff and Tapping Equipment

Power Control Products, Inc., Vicksburg, Mich., a newly formed corporation, is manufacturing a line of air and hydraulic automa-



Drill press equipped with automatic spindle-reversing tapper conversion unit made by Power Control Products, Inc.

tion equipment. Tooling of the new plant has been completed and manufacturing operations are under way. Included in the new line will be a fully automatic, 14-inch high-speed cutoff machine and an automatic spindle-reversing tapper conversion unit for any standard type of drill press.

The electronic tapping device consists of an electrically interlocked reversing control panel which mounts on the right side of the drill-press head, as shown in the illustration, and a cam-operated hand feed-wheel with switching control. Designed to tap to the capacity of presses up to 2 hp, the unit makes possible the use of heads for multiple-spindle tapping. It also permits use of the same fixtures for drilling and tapping. The components are said to mount quickly and easily.

Addition of this unit converts any standard drill press to a tapper-drill press combination, and it can then be used either way by throwing a toggle switch. Another toggle switch converts from right- to left-hand threads. Signal lights on the control panel indicate the settings at a glance.

To assure high accuracy and quality threads, the machine provides perfect directional synchronization of vertical spindle travel and tap rotation. When tapping, the handwheel control simultaneously reverses the direction of both the spindle feed and tap rotation. Thus, the tapping depth and point of reversal of the motor are automatic and the need for clutches is eliminated.

Circle 610 on Readers' Service Card

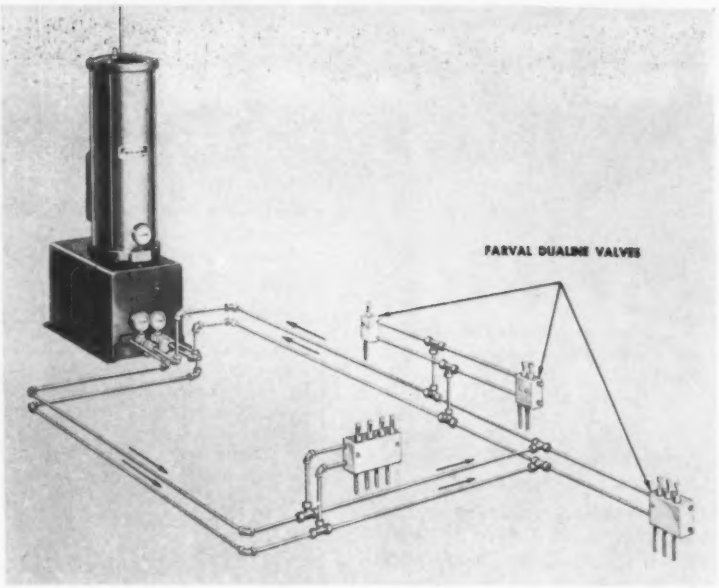
Acme Circular Chain for Conveyor Systems

Two special features demonstrated by the Acme Chain Corporation, Holyoke, Mass., at the recent Design Engineering Show were their offset side-bar series of conveyor chain, consisting of Nos. 3100, 3120, 3140, and 3160. These chains are also offered in the multiple widths. Along with the new offset side-bar series, Acme displayed the circular conveyor chain, which is designed to operate on anywhere from 45- to 320-degree power turns.

Information and engineering data on the offset side-bar chain and circular chain was made available at Acme's booth. Acme's exhibit emphasized the offset side-bar and circular chains. The adaptation of colored transparencies also enhanced the general display of roller chains, sprockets, attachments, flexible couplings, and other power transmission products.

Circle 611 on Readers' Service Card

Farval-Tanway Lubricating System



Lubricating system to be demonstrated by Farval Division, Eaton Mfg. Co.

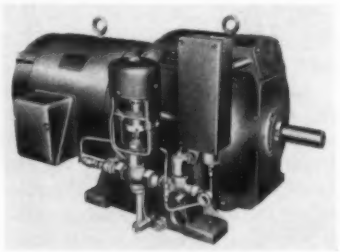
Various methods of lubricating a number of bearings will be demonstrated by the Farval Division, Eaton Mfg. Co., Cleveland, Ohio, at the 1961 Design Engineering Show in Detroit. Emphasis is being placed on working models of actual systems.

Designers will be especially interested in the Farval-Tanway system. This is an addition to the Farval line designed to economically serve the lubrication requirements for small machines. Power sources for this system include choice of pneumatic, hydraulic, electric (motor-driven), mechanical (cam-operated), or manual operation.

Circle 612 on Readers' Service Card

Dynaspede Drives of Improved Design

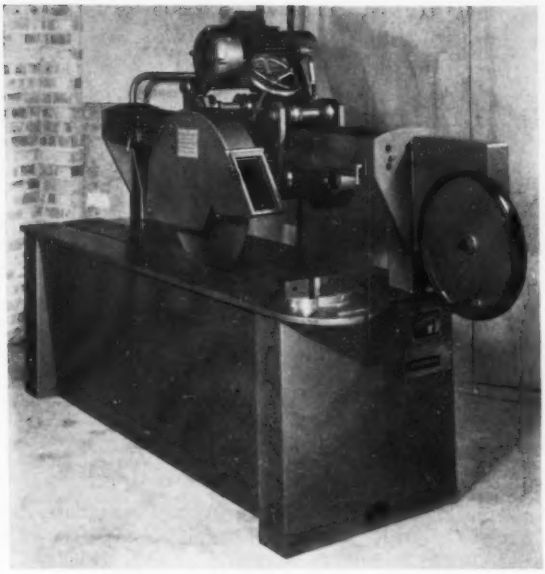
New models of the 1961 Dynaspede drives have been introduced by the Dynamatic Division, Eaton Mfg. Co., Kenosha, Wis., at the Design Engineering Show, Cobo Hall, Detroit, Mich., May 22 to 25, at Booths 656, 660, and 662. The new models are said to contain many improvements which have resulted in a more compact, higher horsepower unit especially designed for wider application in industry. Five model sizes are included in the latest refinements. A typical example of the increased performance is shown in the Dynaspede No. 212, which was formerly rated at 40 hp at 1800 rpm. The new equivalent model, which is No. 2123, is rated at 75 hp. (Dynaspede is the Dynamatic Division's trademark term for water-cooled, eddy-current variable-speed drives.)



Dynaspede drive made by Dynamatic Division, Eaton Mfg. Co.

Torque capacity has been increased through the better uses made of magnetic materials which are the result of a two-year development program by Dynamatic's metallurgical laboratory. The magnetic system used to generate eddy current has also been improved by more efficient use of magnetic fields.

Circle 613 on Readers' Service Card



Long-bed, traversing high-speed cutoff saw introduced by Production Machinery, Inc.

Selas automated machine for processing die-cast aluminum rotors for electric motors

Traversing Cutoff Saw

A Promacut Uni-9A long-bed traversing cutoff saw that combines high cutting speed with ability to handle stock such as grating and other structurals in making cuts up to 12 feet in length has been announced by Production Machinery, Inc., Chicago, Ill. No clamping of the work or the use of coolant is required when operating this saw. It employs the basic Promacutting principle, which depends upon a unique tooth shape in an alloy-steel circular saw. This produces a semimilling action rather than biting and chipping in the manner of conventional cutoff equipment. Speed of rotation and high torque moves the blade through stock so fast that heat is not absorbed and the result is an almost burr-free cut with no bluing of the metal. The approach of the saw to the stock holds the work in position.

The unitized head travels on eight V-rollers and is fed either manually by a geared handwheel or may be equipped for automatic feed and return. The machine is available in five sizes, with cut length capacities ranging from 48 to 144 inches. It is powered by a 12.5-hp sealed motor which operates on a 3-phase, 60 cycle circuit of 220/440 volts.

Circle 614 on Readers' Service Card

Automated Postheating Machines

Automated graduation postheating machines, job-engineered and manufactured by Selas Corporation of America, Dresher, Pa., are being used to step up production and improve the quality of die-

cast aluminum rotors for electric motors. In some instances, the heat imparted to the rotors for postheating is utilized also to shrink-fit the shafts and rotors. Stray filaments of aluminum, forced between the steel laminations of the rotors during die casting, tend to reduce motor efficiency. These are broken up by postheating, which consists of conveying the rotors on rotating fixtures through two radiant heat zones to raise the rotor temperature to a point just below the melting point of the aluminum. This heating imparts a differential expansion between the steel laminations and the die-cast metal, with a tendency to shear off and round off the stray portions of the aluminum conductor bars that have been forced between the steel laminations.

The rotors are postheated in three to four minutes at production rates up to 400 per hour. Cycles can be varied to accommodate a range of sizes and shapes of rotors by adjusting the conveyor speed and/or the temperature setting.

Circle 615 on Readers' Service Card

Compact "Speedlap" with Reversible Lap Plate

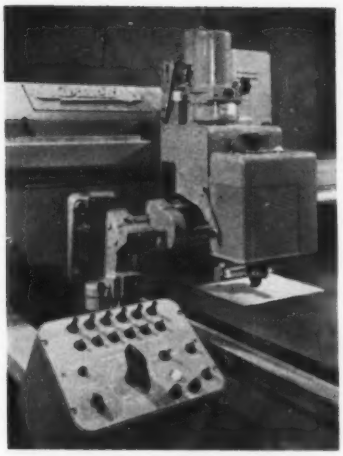
The Speedlap Corporation, Skokie, Ill., has announced the addition of the "Speedlap" 12 12-inch lapping machine to its quality line of lapping equipment. This Speedlap is constructed of stainless steel and has a "Speedalloy" reversible lap plate serrated on one side and solid on the other. It has been especially designed for compactness and economy. The Speedlap has four 4 1/2-inch inside-diameter rings which eliminate much pregrinding and provide 49 per cent greater lapping area than was previously available with preceding equipment.

The abrasive compound is applied automatically and a quick change can be made in the abrasive size or type. This lapping machine is built to the same high-quality standards as the other machines in the Speedlap line, which includes the 18-, 24-, 32-, 48-, 64-, and 84-inch sizes.

The Speedlap 12 is claimed to maintain positive flatness control, which makes it ideal for short production runs and production of small parts. It is usable by research laboratories, solid-state metallurgical development laboratories, design engineers, maintenance shops, tool and die shops, laboratories, and even completely equipped home work-shops. Because it is constructed of stainless steel there is no contamination. It produces flatness to 0.000003 inch and better with a surface finish of 2 micro-inches and better and a parallelism tolerance of 0.00005 inch. Also, it offers precision work at production speeds.

Circle 616 on Readers' Service Card

Speedlap of stainless-steel construction with reversible lap plate



Linde photocell tracer guided by pencil sketch

Oxweld Unit with Photocell Tracer

An Oxweld CM-56 unit equipped with a revolutionary new tracing system is announced by Linde Company, division of Union Carbide Corporation, New York City. The Linde photocell tracer (on the right) is being guided by a simple exact-size pencil sketch on ordinary paper of the intricate shape being reproduced.

Circle 617 on Readers' Service Card

Schrader Pistol Grip Blow Gun

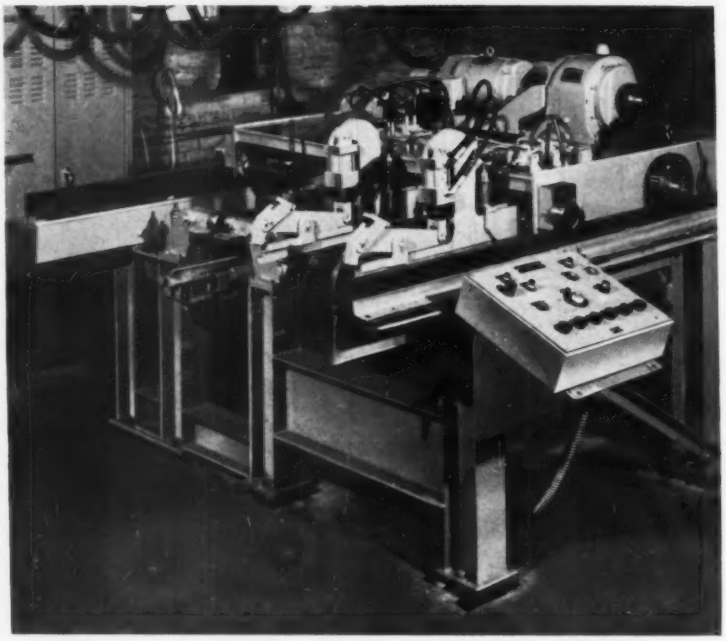
A pistol-grip blow gun designed to provide safe, comfortable, easy-to-control operation is announced by A. Schrader's Son, division of Scovill Mfg. Co., Inc., Brooklyn, N. Y. This gun is adaptable to a wide variety of uses, from fast drying of work to clearing chips from work-tables and removing

Blow gun for drying and cleaning work announced by Schrader

dirt or oil from dies. Its lightweight aluminum construction (only 6 1/2 ounces) permits continuous use on production lines with minimum effort. The comfortable nonslip pistol grip is designed to assure safe handling even when the operator's hands are greasy and the positive nonpinch trigger action meters the air flow from a whisper to a wide open blast as needed. A convenient hang-up hook on the gun keeps it out of the operator's way when not in use.

Circle 618 on Readers' Service Card

Spacing-Table Carriage with Numerical Control for Punching Structural Shapes



Beatty spacing table with numerical control for punching structural shapes

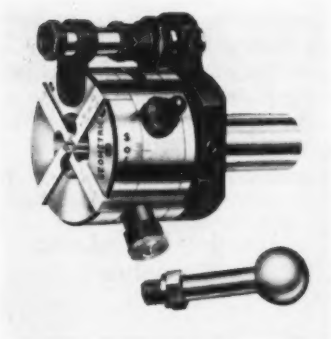
Numerical control of a spacing-table carriage for punching structural shapes, using tape or dials, is an automation development announced by Beatty Machine & Mfg. Co., Hammond, Ind. The unit feeds structurals weighing up to 18,000 pounds of any length through a guillotine beam punch that punches rivet or bolt holes in webs and flanges in any desired position along the work. The unit is offered in three different speed and weight combinations and in length multiples of 10 feet. Dial-control settings are made to decimal equivalent dimensions. Tape and dial control can include operation of punch gages, positioning devices, and machine clutch. Controls provide back stepping where required.

Positioning of the work is extremely accurate, and is said to surpass conventional tolerances. Minimum spacing can be as little as 1/32 inch. Three years of development and testing in cooperation with the General Electric Co., whose control is used to position the carriage automatically, went into the unit. It can be installed on Beatty spacing-table and punch units already in use.

The beams ride on conveyor wheels and are attached by hydraulic clamps to a motor-driven carriage and pulled through the punch. On standard units the operator rides on the carriage and positions the work by operating push buttons and a handwheel. He also reads the position from a steel scale mounted on the bed of the runout table; and when in position, he signals the helper to operate the punch. With the new unit the carriage, as well as the punch, operates automatically.

Circle 619 on Readers' Service Card

Geometric New-Size Die-Head



New-size die-head added to DSA line manufactured by the Geometric Tool Co., New Haven, Conn. In addition to its previously introduced DSA 5/16-, 6/16-, and 2 1/4-inch die-heads, Geometric is now prepared to furnish 1/2-inch die-heads for the 00 (new capacity) Brown & Sharpe automatics.

Circle 620 on Readers' Service Card

"Snap-Plug" Gage

Adjustable internal "Snap-Plug" gage, designed to permit both "Go" and "Not Go" to be checked at one insertion of the gage into the work-piece, announced by N. A. Woodworth Co., Erin, Tenn. A simple movement of the wrist upward denotes whether the part is in size or oversize. The gage eliminates the need for many individual cylindrical plug gages by having an adjustable range of 2 to 4 inches. Conditions such as taper, bellmouth, and out-of-roundness can be readily detected.

The cast-aluminum frame is lightweight and durable. Gage pins are interchangeable and replaceable. Carbide-tipped pins are available at nominal cost. A complete kit contains handle, sixteen gage pins, micrometer type centralizing gage, adjustment wrench, and complete operating instructions.

Circle 621 on Readers' Service Card

Armaloy Extra-Long Wrenches

One of a line of twenty-four Armaloy extra-long combination open end-box pattern wrenches with nominal openings ranging from 3/8 to 2 inches and lengths from 7 to 30 inches announced by Armstrong Bros. Tool Co., Chicago, Ill. These wrenches are particularly useful where additional leverage is required to loosen tight nuts. They are offered in addition to the company's standard-pattern combination wrenches, which will be continued.

Circle 622 on Readers' Service Card

Slocomb Utility Micrometer

Utility micrometer designed to quickly and accurately measure compound curvatures on airfoil surfaces and other curved parts introduced by the J. T. Slocomb Co., South Glastonbury, Conn. This micrometer has an anvil and spindle comprised of small-diameter pointed terminals adapted for accurate measurement of parts with curved surfaces. It has a

measuring capacity of 0 to 1 inch and a 3-inch deep-throated frame. Hence, it can measure 3 inches in from the edge of an airfoil section. It is especially useful for testing wall thicknesses on tubing or other curved parts, reaching in where ordinary 1-inch deep-throated micrometers cannot be used. The size of the micrometer opening also makes it possible to measure materials which are flanged and could not be measured with the standard 1-inch mike.

Circle 623 on Readers' Service Card

Hannifin Air-Pressure Regulators

Crown "Pilot Controlled" regulator designed for remote regulation of inaccessible air lines brought out by the Hannifin Co., Des Plaines, Ill., a division of the Parker-Hannifin Corporation. In this regulator, a column of controlled-pressure air replaces the adjusting screw and control spring used in standard regulators. This air column applies a constant force on the diaphragm, and is governed by a pilot regulator operating at practically "no flow" to assure prompt response, highest air-flow rate, and accurate pressure control. When the line to be controlled is not easily accessible, the "Pilot Controlled" regulator can be installed out of reach. Any size regulator having the desired pressure range may be used as the pilot regulator, and may be mounted in any convenient location. It can even be installed in a locked box, or in another room so that pressure setting will be tamper-proof.

Circle 624 on Readers' Service Card

NEWS of the Industry

Isabel Shamlian

California

DYNAMIC GEAR CO., INC., Amityville, N. Y., has announced the opening of a new facility in Van Nuys, Calif. The new plant, known as Dynamic's western division, is a completely staffed and self-contained facility for the production of precision stock gears, components, and complete assemblies. PETER BUSCHELLE is regional sales manager and will act as temporary general manager of the new division.

JAMES G. SWIFT has been named a field engineer for DENISON ENGINEERING DIVISION, AMERICAN BRAKE SHOE CO., Columbus, Ohio. In his new position, Mr. Swift will be responsible for the sale of Denison hydraulic pumps, controls, and systems in the southern California area and the states of Utah and Arizona. He will make his headquarters at the company's regional office in Hawthorne, Calif.

BURG TOOL MFG. CO., INC., Gardena, Calif., has announced a change in its name to BURGMASTER CORPORATION. Formerly, Burgmaster Corporation was the small tool part of Burg Tool Mfg., but it will now be known as the small tool division of the Burgmaster Corporation. It will handle the bench model Burgmaster turret drill, hand positioning table, Toolflex tool-holders, and other machine accessories.

KENNETH C. BRADLEY has been made machine tool sales representative for the Los Angeles, Calif., office of PRATT & WHITNEY CO., INC., West Hartford, Conn. Prior to his association with P&W, Mr. Bradley was sales engineer and regional sales manager for a nationally known manufacturer of machine tools.

EX-CELL-O CORPORATION, Detroit, Mich., has announced the establishment of direct factory sales and service of machine tools for the southern California area. The new office—known as EX-CELL-O MACHINERY SALES—is in the Ex-Cell-O plant in Downey, Calif., and will have HOWARD H. SCHROCK as district manager.

ALDO J. SARTOR, sales engineer, has been transferred to the Pasadena, Calif., office of PANGBORN CORPORATION, Hagerstown, Md. A precision finishing specialist, Mr. Sartor joined Pangborn's Detroit, Mich., staff in 1960.

Illinois and Indiana

TEXTILE MACHINE WORKS, Reading, Pa., has acquired the capital stock of J. L. FERGUSON CO., Joliet, Ill.

HOWARD E. MILLS has been made manager of the Richmond regional machine tool sales office by NATIONAL AUTOMATIC TOOL CO., INC., Richmond, Ind. Mr. Mills has been associated with NATCO for twenty-four years, the past ten years as sales engineer in the Chicago, Ill., regional sales office.

Michigan and Wisconsin

ROBERT L. PLETCHER has been made a sales engineer at FAB-TEC, a subsidiary of F. JOS. LAMB CO., Detroit, Mich. His new responsibilities, in addition to sales, include coordinating engineering and design of projects, installation and supervision follow-up, and preliminary design of special projects. He has been assigned to cover part of Detroit and the midwest in addition to the east-coast region.

The advancement of ROBERT L. CURTIS to the position of sales manager of all T-J products has been announced by TOMPKINS-JOHNSON CO., Jackson, Mich. Prior to this appointment, Mr. Curtis was technical service manager and advertising manager.

DAVID H. BAKER has been elected by VICKERS INCORPORATED, division of SPERRY RAND CORPORATION, Detroit, Mich., as a vice-president of

David H. Baker, vice-president, Vickers Incorporated; general manager—international division

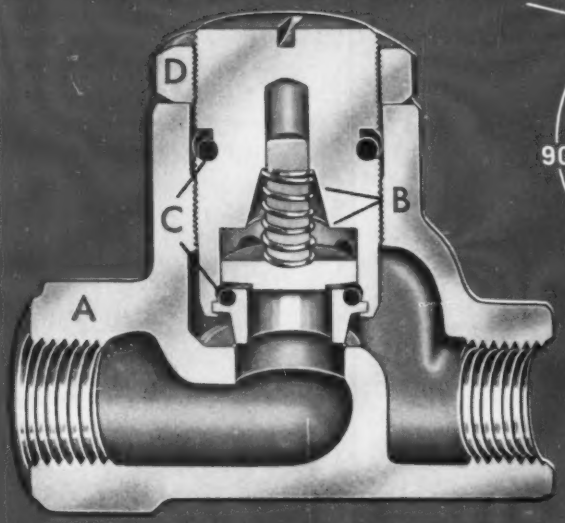
Vickers and general manager of its international division. Mr. Baker succeeds R. E. ESCH, who is retiring.

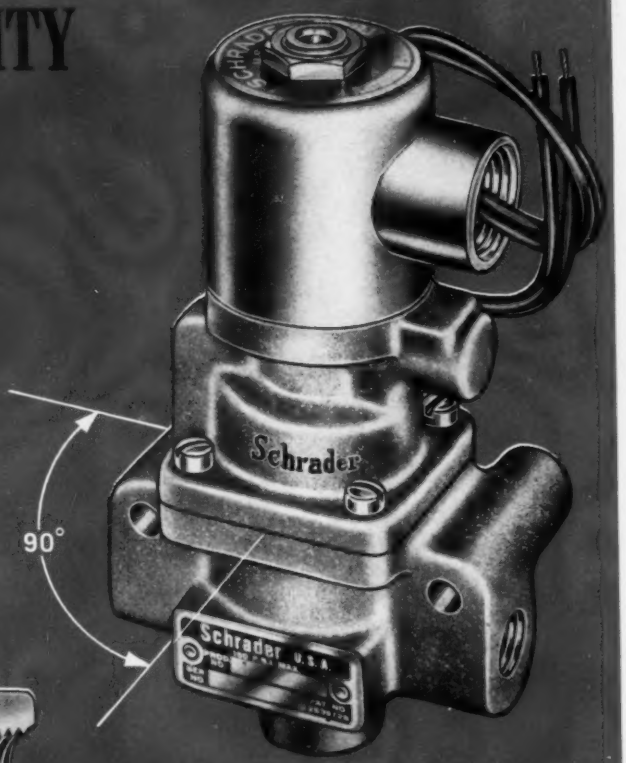
FAMCO MACHINE CO., Kenosha, Wis., has appointed L. G. (BUD) ENROTH general sales manager and C. GEORGE MATTUSCH assistant sales manager. In his new duties, Mr. Enroth will be in complete charge of sales, sales promotion, and sales training. As field sales manager, Mr. Mattusch will be in a position to assist Famco distribution in increasing coverage and sales efficiency.

New England

WYMAN-GORDON CO., Worcester, Mass., has appointed LOREN K. HUTCHINSON manager of operations for the eastern division. He is responsible for all manufacturing, product engineering, and estimating for both the Worcester plant and the company's USAF-leased plant at North Grafton, Mass. Other promotions within the company included the appointment of ARTHUR H. SWIFT as director of plant and equipment engineering for the division, HERBERT K. SAMPSON as manager of production development, O. FRANK BURBANK as manager of product en-

THERE'S A QUALITY DIFFERENCE IN AIR CONTROL COMPONENTS...





...you can see the difference in any Schrader Air Product

FOR EXAMPLE: Schrader Flow Control Valves—a unique combination of a poppet by-pass valve and a large "cone seat" metering valve provides full air flow in one direction and carefully controlled flow in the other. (A) Body of cast brass. (B) Compact plunger assembly replaceable in one unit. (C) "O" ring seal for surest airtight performance. (D) Extra-fine screw thread adjustment for vernier-like setting and sturdy lock-nut to hold adjustment even under rough treatment.

ANOTHER EXAMPLE: Solenoid-operated 3-way Valves by Schrader permit electric control of air power and make possible new versatility and compactness in automation and machine design. Typical feature . . . by shifting pilot chamber head 90° a normally-open type may be changed to normally-closed, and vice versa. This poppet type valve, has a self-cleaning seat and provides full air flow assuring optimum characteristics for cyclic operations. Available in five pipe sizes from ¼" to 1".

FULL LINE OF QUALITY AIR CIRCUIT COMPONENTS • OFF-THE-SHELF SERVICE AND INFORMATION FROM YOUR NEARBY DISTRIBUTOR • STAFFED WITH AIR CIRCUIT EXPERTS • CONSULT YELLOW PAGES OR WRITE FOR HIS ADDRESS

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Co., Inc.
454 Vanderbilt Ave., Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

For more data circle this page number on card at back of book

gineering and estimating, and WILLIAM J. BARLOW as supervisor of estimating. ROBERT A. EDDY was made plant manager at the Worcester plant, with ARTHUR A. WENTZELL as superintendent of production engineering. ALAN CROWELL became superintendent of Worcester plant engineering and maintenance. RANALD F. GOODSPEED was named superintendent of plant engineering and maintenance at the North Grafton plant and JOHN D. MCKEOGH became assistant superintendent there.

HEALD MACHINE CO., Worcester, Mass., announced the following changes in its organizational alignment. The company will be organized into two main divisions by product line—the grinding machine division and the Bore-Matic machine

A. Francis Townsend, newly named vice-president and manager of the grinding machine division, Heald Machine Co.

Albert A. Arbogast, manager of the Bore-Matic machine division, Heald Machine Co.

G. Harding Allen, new works manager of Heald Machine Co.

division. A. Francis Townsend has been named vice-president and manager of the grinding machine division, while Albert A. Arbogast has been made manager of the Bore-Matic machine division. In addition, G. Harding Allen has been promoted to works manager for the company, and Edwin J. Keyes is vice-president of manufacturing.

Caleb Warner has joined the staff at Magnion, Inc., Cambridge, Mass., as general manager. In his new capacity, he will have charge of proprietary development as well as contract research in the company's Plasmaflux and Uniflux lines of magnets for general laboratory use, MHD work, plasma studies, energy conversion, and ion-beam focusing and bending. He will also head the high field-pulsed magnet work and development in superconducting magnets.

Everett A. Cooper has been elected a vice-president of Emhart Mfg. Co., Hartford, Conn. He has been administrative assistant to Sixten F. Wollmar, Emhart's president, since joining the company in 1957.

Pratt & Whitney Co., Inc., West Hartford, Conn., has named Mark G. Channing vice-president in charge of planning. Mr. Channing will be head of planning and programming functions, including long-range corporate planning, cost controls, business research, and product planning. Also announced was the appointment of Charles L. Olson as sales-service engineer for cutting tools and conventional gages and George A. Crittenden as assistant sales manager, distributor products.

Keith T. Middleton, announced as newly elected president of Fafnir Bearing Co.

Clarence G. Rosensweig, newly appointed vice-chairman of the board, Fafnir Bearing Co.

FAFNIR BEARING CO., New Britain, Conn., has announced the election of KEITH T. MIDDLETON as president of the company, succeeding CLARENCE G. ROSENSWEIG, who was elevated to vice-chairman of the board. Mr. Middleton was formerly executive vice-president and secretary. He becomes chief operating officer. Also announced was the appointment of RANDOLPH B. ROBERT as secretary as well as treasurer.

ROBERT S. JONES has been elected vice-president and general manager of JONES & LAMSON MACHINE CO., Springfield, Vt. Mr. Jones started with J&L in 1940 as a machine operator and has successively held various other positions until his present appointment.

CONE AUTOMATIC MACHINE CO., INC., Windsor, Vt., has announced the appointment of J. ARNOLD KIELY

J. Arnold Kiely, new executive vice-president of Cone Automatic Machine Co., Inc.

Robert R. Rhodehamel, new vice-president in charge of manufacturing, for the Cone Automatic Machine Co., Inc.

as executive vice-president of the company. In addition, ROBERT R. RHODEHAMEL has been named vice-president in charge of manufacturing.

New York and New Jersey

The appointment of IVOR THOMPSON as vice-president has been announced by CERRO SALES CORPORATION, a subsidiary of CERRO CORPORATION, New York City. Mr. Thompson will be responsible for the marketing of all nonferrous metals

produced by CERRO DE PASCO CORPORATION, the firm's subsidiary operating in Peru.

ELMER A. RICH has been promoted to the presidency of LAKE ERIE MACHINERY CORPORATION, Buffalo, N. Y., a subsidiary of BELL INTERCONTINENTAL CORPORATION. Mr. Rich, vice-president and general manager of Lake Erie Machinery since 1959, succeeds JAMES F. CONNAUGHTON.

DYNAMIC GEAR CO., INC., Amityville, N. Y., has purchased GEAR PRODUCTS & MFG. CO., Syosset, N. Y. Gear Product's facilities will be entirely integrated into the parent company's manufacturing organization.

MORGAN A. GAGE has been named assistant director of industrial relations by GLEASON WORKS, Rochester, N. Y. He has been a sales engineer with Gleason since 1953.

WALTER OSTROM has been named chief designer of VOLKERT STAMPINGS, INC., Queens Village, N. Y. Mr. Ostrom joined the company as a designer in 1949.

RIVETT LATHE & GRINDER, INC., Boston, Mass., has appointed HYDRO AIR, INC., Scotch Plains, N. J., as exclusive distributor of its air and hydraulic valves and cylinders in New York City, Connecticut, and northern New Jersey. RON GAUDET will be covering Connecticut; ROBERT E. PFITZENMEIER manages the New Jersey territory; and LEE DRASIN is to manage the Brooklyn office and will cover the New York City territory. Other officers appointed include GEORGE HUSTON and EDWARD SCHWESER.

CARPENTER STEEL CO., Reading, Pa., has made ANTHONY A. MENDES branch manager for the northern New Jersey district. He will be responsible for specialty steel sales in that area directing sales operations from Carpenter's warehouse at Mountainside.

WORTHINGTON CORPORATION, Harrison, N. J., has elected FRED R. ELLENBERGER vice-president—international operations. He succeeds S. RILEY WILLIAMS, who has retired. Mr. Williams will continue with the company as vice-president-consultant.

L. K. SHEPARD has been appointed vice-president—sales of STANDARD TOOL & MFG. CO., Lyndhurst, N. J. He has been with the company since

1958, with responsibility for sales and new-product development.

Ohio

AMERICAN TOOL WORKS CO., Cincinnati, Ohio, has appointed CLETUS WESSELS chief engineer and CHARLES MANGOLD manager of the production department. Mr. Wessels joined the company in 1920; and Mr. Mangold, in 1946.

The appointment of F. W. WITZKE as vice-president and chief administrative officer has been announced by CLEVELAND INSTRUMENT CO., Cleveland, Ohio, a subsidiary of BENDIX CORPORATION. Mr. Witzke, who was previously manager of sales engineering, joined the company in 1956.

The appointment of KENNETH C. HARRIS as manager of marketing research has been announced by DENISON ENGINEERING DIVISION, AMERICAN BRAKE SHOE CO., Columbus, Ohio. Mr. Harris joined the division in 1957 as marketing research analyst.

Pennsylvania

ROCKWELL MFG. CO., Pittsburgh, Pa., has named JOHN H. DIEHL assistant vice-president, manufacturing, for the power tool division. Mr. Diehl will have direct control of the manufacturing operations at Rockwell's Bellefontaine, Ohio, plant and the PORTER-CABLE MACHINE CO. plant in Syracuse, N. Y. Also announced was that DONALD P. HENRY would replace Mr. Diehl as general manager of the Bellefontaine plant, and that DAVID A. A. RIDINGS would become the new vice-president and general manager of the Porter-Cable Machine Co.

AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC., New York City, has appointed S. S. BRUCE, JR., manager of its national railroad sales department in Pittsburgh, Pa. In his new post, Mr. Bruce will coordinate all sales and distribution of Airco products to the railroad industry. He replaces D. J. WILLIAMS, who has retired.

BRUCE O. YOUNG has been appointed manager, carbon and alloy specialties product division, by CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa. He will be responsible for the promotion and sale of drill steels, alloy and carbon specialties, jail steels, agricultural steels, and cold-rolled specialties.

LANDIS MACHINE CO., Waynesboro, Pa., has appointed D. E. STONER, former works manager of the tap division, works manager of the entire plant upon the retirement of LEON H. RANDOLPH. In addition, R. D. HELM, former assistant treasurer, has been made secretary-

D. E. Stoner, newly appointed works manager, tap divison plant, Landis Machine Co.

R. D. Helm, secretary-assistant treasurer, Landis Machine Co.

assistant treasurer, succeeding R. G. MUMMA, who has retired.

REYNOLDS METALS CO., Richmond, Va., has purchased the FORD MOTOR Co. (Dearborn, Mich.) building and plant site at Chester, Pa., for the manufacture of insulated wire and cable products. The $2,200,000 one-story building, located on the Delaware River, has about 650,000 square feet of floor space.

Texas and Alabama

CLECO AIR TOOLS, a division of REED ROLLER BIT CO., Houston, Tex., has announced a recent realignment and expansion of its domestic and foreign sales staff. JOHN HOBBIS, former salesman senior in the firm's Newark, N. J., division, has been transferred to Ohio and promoted to manager of the Cleveland division. WALTER S. SPOTT succeeds Mr. Hobbis as salesman senior in Newark. E. T. PEACOCK has joined Cleco as assistant to the Chicago, Ill., sales division manager. HENRY TABBINER is now with CLECO PNEUMATIC TOOL CO. OF CANADA, LTD., to serve as salesman for the Toronto, Ontario, area.

COVEL MFG. CO., Benton Harbor, Mich., has appointed MILL & MINE SUPPLY CO., INC., Birmingham, Ala., as exclusive distributor of Covel precision surface and cutter and tool grinders. The new representative will cover the state of Alabama and northwest section of Florida along the southern boundary of Alabama.

Canada

CLEVELAND PUNCH & SHEAR WORKS CO., Cleveland, Ohio, has appointed A. R. WILLIAMS MACHINERY CO., LTD., as sole Canadian distributor for Cleveland's line of mechanical power presses and fabricating machines for plate and structural steel. A. R. WILLIAMS companies maintain sales and service offices in twelve leading Canadian industrial centers coast to coast, including Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Calgary, Edmonton, and Vancouver plus special representation in ten additional Canadian cities.

Obituaries

ERNEST EDGAR THUM, director of editorial services of the AMERICAN SOCIETY FOR METALS, Metals Park, Ohio, died suddenly on April 10. His age was seventy-six. Mr. Thum was editor in chief of *Metal Progress*, the society's monthly magazine, and its first editor when the magazine was established in 1930. He was named editor in chief in 1958. Only a month ago he had been appointed director of editorial services in charge of all society periodical and reference publications. He was an international authority on metallurgy, widely known in Europe where he had made many trips in behalf of the society and *Metal Progress*.

JAMES J. JORDAN, retired manager of gas sales promotion of LINDE COMPANY, division of UNION CARBIDE CORPORATION, New York City, died on April 23 at the age of sixty-one. Mr. Jordan was born in Syracuse, N. Y., but grew up in Lynn, Mass. He began his association with Union Carbide Corporation in 1923 as a salesman for Linde Company in Buffalo. After a number of years in the field he was transferred to the general sales office in New York in 1936. He became manager of gas sales in 1940 and manager of gas sales promotion in 1957. Mr. Jordan retired from Union Carbide in 1960.

• • •

Data Sheet Correction

An error in the formula for calculating the capacity of elliptical tanks, which appeared in February, 1961, MACHINERY, page 159, has been called to our attention by Stanley P. Gould, Porterville, Calif. The incorrect formula contained in the last line on the data sheet reads as follows: "For elliptical tanks, mul-

tiply the length by the short diameter by the long diameter by .0339 and divide by 231." The correct formula submitted by Mr. Gould is: "For elliptical tanks, multiply the length in inches by the short diameter in inches by the long diameter in inches by 0.0034."

New Books

PLASTICS TOOLING—SECOND EDITION. By Malcolm W. Riley. 210 pages; 6 by 9 inches; illustrated. Published by Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y. Price, $7.50.

This is a complete revision of the author's guide to the properties and fabrication methods of plastics as they apply to a tooling program. Many of the materials and techniques described in this second edition are new—e.g., metal fiber-reinforced epoxies—and some are even developmental, such as gas or electroless nickel-plated surfaces for plastics tools. The author clearly states the degree of use of each technique discussed, and includes as much data as possible on those materials which have highly promising futures.

Relatively well-defined combinations of physical and mechanical properties of plastics are included, as well as the novel methods by which they can be put into a final tooling shape. There is enough resin chemistry discussed to enable the engineer to work with plastics materials and with suppliers on a sound basis. The book will prove of substantial help to tool engineers and plastics fabricators who want to make an objective choice of materials for a particular type of tool service.

ENGINEERING DRAWING AND GEOMETRY, SECOND EDITION. By Randolph P. Hoelscher and Clifford H. Springer. 587 pages; 8¾ by 10 inches; illustrated. Published by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y.

Since this book is designed for engineers, thoroughness in the understanding of principles has been emphasized rather than manual skills. It is from the viewpoint of developing an engineer rather than a draftsman that the subject matter has been presented.

In Part 2 all the theory in descriptive geometry necessary for the successful solution of problems in design and drafting has been included. This theory has been so arranged that it may be used in a combined and integrated course in both drawing and descriptive geometry or in separate courses if so desired.

Part 3 includes five chapters on various types of graphical computation sometimes loosely referred to as graphics.

The chapters in Part 4 have been designed for sophomore courses in the professional fields. The treatment is thorough and sufficiently detailed so that the student may do problems of a professional character without entering into theoretical design work.

The text has not been confined to the concepts of machine drawing but treats the subject from the broader base of engineering usage as a whole.

CONVERSION FACTORS AND TABLES, THIRD EDITION. By O. T. Zimmerman and Irvin Lavine. 710 pages; 4 1/2 by 6 inches. Published by Industrial Research Service Inc., Masonic Bldg., Dover, N. H. Price, $7.50.

The third edition of this useful work has been increased in size to cover hundreds of new conversion factors and tables. Weights and measures factors for nintey-five countries are included, and every factor has been calculated on the basis of the latest and most accurate fundamental data.

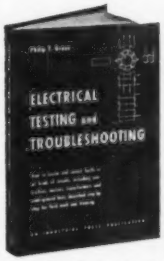
This book should prove of considerable value to scientists, engineers, and anyone else engaged in technical work.

Coming Events

JUNE 11-14—Summer Annual Meeting of the American Society of Mechanical Engineers, to be held at the Statler Hilton Hotel, Los Angeles, Calif. For more information, write to L. S. Dennegar, Meetings Department, American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

SEPTEMBER 28-29—Fourth Annual National Conference and Technical Exhibit of the American Production and Inventory Control Society, to be held at the Pick-Congress Hotel, Chicago, Ill. For more details, contact American Production and Inventory Control Society, 330 S. Wells St., Chicago 6, Ill.

TESTED ELECTRICAL PROCEDURES DESCRIBED BY AN EXPERT



ELECTRICAL TESTING AND TROUBLESHOOTING, by Philip T. Green explains tested procedures clearly and completely.

This book will show you how to locate and correct faults in circuits of all kinds, including—controllers, motors, transformers and transmission lines. A briefing on electrical symbols and diagrams is followed by detailed discussions on: Analyzing and charting controller operation, Insulation testing, Electromagnet winding, Single-Phase transformers, Polyphase transformers, Synchronous motors, Troubleshooting test equipment, Locating grounds, D.C. machine windings, Phase sequence, Induction motors, Power cable faults, Bearing lubrication.

The tests are performed with the equipment isolated from the power line. Current is supplied by dry cells or residual magnetism so that accidental contact and short circuits are less hazardous. All of the trouble shooting procedures described here have been tested and proven to be great time-savers—especially for locating obscure source of trouble.

200 Pages, 100 Illustrations, Flexible Fabrikoid Binding, $5.00.

To order, you may use the handy yellow card that is next to the last page.

THE INDUSTRIAL PRESS
93 Worth Street, New York 13, N. Y.

TRIAL SAMPLE!

SPECIAL LUBRICANT EASES WORKING STAINLESS AND TOUGH METALS

New lubricant eases stamping and machining operations on the toughest metalworking jobs—takes the problems out of hard-to-work metals such as stainless, high carbon, high chrome, cast iron, monel, etc. Scientifically developed ANCHORLUBE now used extensively in a wide range of applications—drilling, tapping, spot facing, counter-boring, milling, fly-cutting, seat forming, engraving, broaching, drawing, piercing, punching, hole extruding, etc. Application by swab, spray, roller or brush. Send today for free trial sample and see for yourself how easy you can work the job with ANCHORLUBE.

ANCHOR CHEMICAL COMPANY
Dept. M-6 • 10721 Briggs Road • Cleveland 11, Ohio

For more data circle item 231A

CAMS

ALL TYPES MADE TO YOUR SPECS!

CAM CALCULATING SERVICE

Write for catalog 55-C

EISLER ENGINEERING CO., INC.
Chas. Eisler, Jr., President
738 South 13th Street
Newark 3, New Jersey

For more data circle item 231B

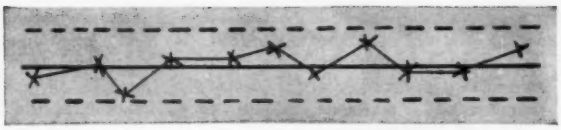
For just $3.00 you get ANSWERS!

Answers to hundreds of questions. BEND? CUT? Then you should have in your library "A Manual of Processes for The Cold Bending of Metals and Abrasive Cut-Machining of Metals."

Order yours today

WALLACE MFG. COMPANY
1310 W. Diversey Parkway Chicago 14, Illinois

For more data circle item 231C



SAYS THE QUALITY CONTROL MAN AT A MAJOR AUTO MANUFACTURER.

COMTORPLUG

FITS PERFECTLY INTO THE REQUIREMENTS OF

STATISTICAL QUALITY CONTROL

Here's why-

ACTUAL SIZE

Comtorplug indicates the actual dimension, easily readable to .00005".

FIXED READING

Not a passing approximation, Comtorplug gives a fixed reading of the actual dimension.

REPEATABLE

Built-in features assure that various operators get the identical reading. Comtorplug automatically gives: self-alignment, self-centering and uniform gaging pressure.

2-POINT GAGING

Automatic 2-point contact permits taking the diameter at any point, front to back as well as axially. Thus Comtorplug detects front or back taper, ovality, etc., and shows the exact amount of the deviation.

Request Bulletin 51

COMTOR CO.
74 FARWELL STREET
WALTHAM 54, MASS.

For more data circle item 231D

OCTOBER 23-27—1961 Detroit Metal Show and ASM Materials Comparison Center, to be held in Cobo Hall, Detroit, Mich. For additional detail, contact William J. Hilty, exposition manager, American Society for Metals, Metals Park (Novelty), Ohio.

OCTOBER 23-27—Forty-Third National Metal Congress, presented by the American Society for Metals and eight participating organizations, to be held in Cobo Hall, Detroit, Mich. For more information, contact T. C. DuMond, manager, metal congresses, American Society for Metals, Metals Park (Novelty), Ohio.

• • •

Revised Standard for Bearing Components

A revised American Standard citing specifications for ball- and roller-bearing lock-nuts, removal nuts, lock plates, lock washers, and taper adapter sleeves has been announced by the American Standards Association, 10 E. 40th St., New York 16, N. Y. Entitled "American Standard Specifications for Bearing Mounting Accessories, B3.9-1960," the standard was originally developed by the Anti-Friction Bearing Manufacturers Association and processed through ASA Sectional Committee B3. Representatives from fifteen national groups of makers and users participated on the committee, representing industrial, technical, and governmental interests. The standard also contains dimensions, tolerances, materials, heat-treatment, and surface finish for bearing mounting accessories.

• • •

Films Instruct Training Supervisors

Four new films for supervisory training have just been announced by Modern Management Films, a division of the Bureau of National Affairs, Inc., 1231 24th St., N. W., Washington 7, D. C. Suitable for office or plant supervision, the films are short 16-millimeter sound and color motion pictures, designed to teach basic principles of supervision and stimulate discussion of supervisory problems.

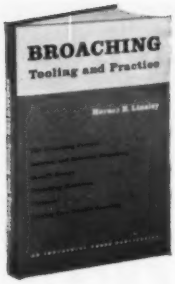
With the addition of these films, the Modern Management Film series now provides training aids for four important problem areas of supervision: giving orders and instructions, listening, motivating employes for higher productivity, and leadership. Each film is accompanied by a leader's guide to assist trainers and conference leaders in conducting a one-hour training meeting with maximum results. The first of the four films is entitled "Instructions or Obstructions." Professor Paul Pigors, of the Massachusetts Institute of Technology, is the expert in this film. By use of an entertaining story and some humorous examples, he illustrates his "seven steps in the order-giving process," which every supervisor should follow for best results. This documentary movie is designed to help supervisors do a better job of verbal communication with subordinates, and to show how to get voluntary cooperation from employes in carrying out orders.

The second lesson is called "Listen, Please." It highlights the importance of listening in the supervisor's every-day job. In a series of episodes at home and at work, the story shows how a supervisor's day is ruined by failure to listen to things other people were trying to tell him. In the end, he learns *why* listening is so important. In the follow-up discussion of the film supervisors are motivated to do a better job on this serious aspect of communications.

A third aid to supervisors is "The Case of the Missing Magnets." In this story, the "missing magnets" represent lost productivity in a department where employe attitude is poor. Viewers watch the supervisor as he tracks down the "clues" which make the difference between high-producing and low-producing departments. The film reviews the basic principles of human relations, while at the same time helping supervisors to understand that discipline—"a taut ship"—goes hand in hand with human relations to build increased productivity.

The final picture in the series helps supervisors identify the various elements which make up leadership and to tie these patterns in with their own daily jobs. An example is by telling a story of five men on a hunting trip who face a crisis which threatens their lives. One man assumes leadership, and as he plans and organizes their survival he demonstrates all of the various attitudes and skills which mark a leader in any situation. In discussion following this film, supervisors are encouraged to start self-development in these same attitudes and skills.

These films may be purchased either singly or in series. They are also available for rental or executive preview.



A BOOK THAT EXPLAINS THE INS AND OUTS OF BROACHING

Everyone concerned with or interested in broaching will shout praises for "BROACHING—TOOLING AND PRACTICE." Manufacturers in the metalworking field . . . metalworking executives . . . supervisory personnel . . . manufacturers' engineers . . . engineering students . . . will find in this book a wealth of valuable information on broaching—from a description of the basic processes and its application, to setting up and trouble shooting.

Never before—until now—has an attempt been made to put into book form the accumulated experiences of manufacturers and users of broaching machines and tools. There is a serious lack of knowledge about the broaching process. Fear of high tooling costs has caused the metalworking industry to shy away from the broaching process. It is true that broaching tools are expensive, but measured in terms of useful life and productive capacity, the methods discussed in this book can help you lower cost-per-part faster than the conventional methods now in use. BROACHING—TOOLING AND PRACTICE is the first book of its kind to cover the field in depth. It is the first to give information on broaching that will help those who plan cost-reduction programs to increase production and lower costs.

This unique book, in seven fact-filled chapters, covers the entire field of broaching—internal, external, vertical, and horizontal, and explains how each type of machine operates, and for which type of work each is best suited. Beginning with the broaching process, this guide gives information on broaches, broachability of materials, cutting fluids, and a definition of standard terms used in broaching. Under the heading of internal broaching, rotary-cut and double-cut broaches, and portable, blind-hole, strip, and rotary broaching are fully discussed and amply illustrated. The chapter on external broaching explains the built-up design construction of broaches, and also covers progressive broaching, cutting rack and gear teeth, slotting, straddle broaching, chain broaching and ring broaching.

In the area of broach design, the book provides information on broach strength, stock removal ability and chip-carrying capacity. In addition, such items as pitch, chip space, face angle, land and clearance angle, and cut per tooth are thoroughly discussed.

Other sections of the book go into the various types of broaching machines and broaching controls. The design of broaching tools and fixtures is covered in detail, and examples of special and unusual broaching operations are given.

Skyrocketing production costs demand new techniques that will remove metal much faster and more economically. A careful study of the pages in this book will acquaint the reader with the many advantages of the broaching process—primarily its ability to lower costs and increase accuracy far better than many other processes. If you are in any way connected with the metalworking industry, and interested in knowing more about the potentialities of broaching, BROACHING—TOOLING AND PRACTICE will prove to be a valuable asset to your engineering library.

THE INDUSTRIAL PRESS, 93 Worth St., NEW YORK 13, N. Y.

Please send me a copy of BROACHING—TOOLING AND PRACTICE @ $6.50.

☐ Payment enclosed ☐ Bill Me ☐ Bill Company

Name .....

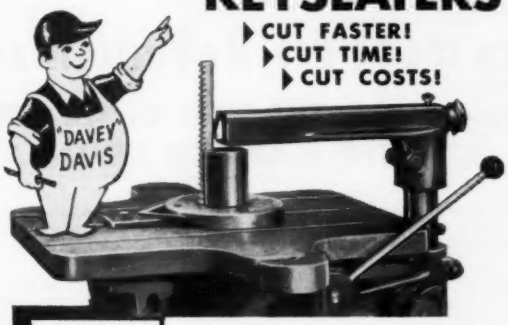
Address .....

Company .....

City ..... Zone .... State 0214

Little "Davey" says: DAVIS KEYSEATERS

▶ CUT FASTER!
▶ CUT TIME!
▶ CUT COSTS!



WRITE TODAY for FREE Literature

"Davey" knows that machinists' time is valuable today and that by using the Davis multiple tooth cutter principle, time is cut to a fraction of the single tooth method. Adjustments are held to a minimum and cutting speed is always maximum, regardless of size or length of cut, or the material being worked. Simple to use even for an unskilled operator. Many of our original models are still giving efficient service after years of use. Tell us your problem. We'll be glad to help solve it.

DAVIS KEYSEATER COMPANY

Division of Hansford Manufacturing Corporation

3114-C Winton Road South, Rochester 23, New York

For more data circle Item 233A

DYKEM STEEL BLUE

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME

END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

THE DYKEM CO., 2303R NORTH 11TH ST., ST. LOUIS 6, MO.

For more data circle Item 233B

GEARS—ALL MAKES . . . Special and standard

PRECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy
Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. Co.

1470 Chestnut Ave. **Hillside, N. J.**

For more data circle Item 233C

Classified and Resale Section

CLASSIFIED ADVERTISING RATES: $16 per single column inch

eastern Rebuilt Machine Tools

THE SIGN OF QUALITY
THE MARK OF DEPENDABILITY

The listing below is only a VERY SMALL AMOUNT of the total number of machine tools that we have in stock for immediate shipment. Our prices are realistic with today's market and our quality of rebuilding is the same high standard—THE LEADER IN THE FIELD OF REBUILT MACHINE TOOLS.

SAWS

Model V-60 Do All Contour Sawing, Filing & Polishing Machine
No. 4B Robertson Economy, m. d., new
No. 32B Cochran Bly Cold Saw, m. d., latest
Model 102, Type JCAW, Cincinnati Elec. & Abrasive Cut-Off, m. d.
6x6" Peerless High Duty Hydraulic Standard, m. d.
Type 36W Do All H.S. Band Machine, vari speed, m. d.
9x9" Quick Cut Hack Saw, m. d.

SHAPERS

12" Rockford Universal Hydraulic, Flanged, m. d.
16" Rockford Hydraulic Universal, m. d.
20" Cincinnati H. D., Plain Back Shaper, late
24" Cincinnati H. D., Plain Back Geared Crank, m. d.
32" Cincinnati, m. d., late
36" Ohio Heavy Duty Back Geared Crank, m. d., late
38" Morton Push Cut, m. d.
48" Morton Heavy Duty Traveling Head, m. d.

SHEET METAL MACHINERY

No. 3—⅝" capacity Gray Sheet Metal Cutter, m. d.
No. 11 SBC Buffalo Armor Platex Bar Cutter, m. d.
Model 1236 Libert High Speed Nibbler Type Shear, m. d.
No. 5 Hilles & Jones Pyramid Type Bending Roll
12'x½" capacity Model 21x10" Cincinnati Press Brake, m. d.
Model U 196B Peck-Stow-Wilcox Under-Driven Power Squaring Shear

SLOTTERS

20-24" Pattern Dill, m. d.
20" stroke Rockford, m. d.
22" Betts, m. d.
48" Niles, m. d.

TAPPERS

No. 1 Bakewell, m. d., late
No. 10 Model 2100 Warner & Swasey Bench Model, m. d.
No. 11 Warner & Swasey, m. d.

TURRET LATHES

No. 1 Warner & Swasey "Electrics", m. d., bar
No. 1A Warner & Swasey, m. d., late
No. 2L Gisholt, m. d.
No. 2H8 Libby, 1942
No. 2A Warner & Swasey, m. d.
No. 3 Gisholt, m. d., 1945
No. 3 Warner & Swasey Ram Type, m. d.
No. 3A Warner & Swasey, m. d. 6" hole extra long bed
No. 3A Warner & Swasey Universal, m. d., late
No. 3L Gisholt, m. d., 1943
No. 3 AL Gisholt, H.D. Full Universal, with cross sliding turret, 1940.
No. 5R Gisholt Universal Hollow Hexagon, m. d.
No. 4 Midland Universal Ram Type, m. d.
No. 4 Warner & Swasey Universal Ram Type, m. d.
No. 4 Gisholt, 1943
No. 4 Jones & Lamson Universal Ram Type, m. d.
No. 4A Warner & Swasey Universal Hollow Hexagon, m. d.
No. 4A Warner & Swasey, hard ways, 1945
No. 4 FU Foster Fastermatic, m. d., latest, 1945
No. 4H—12 Libby, m. d.
No. 4R Libby Ram Type, m. d. in base
No. 4R Gisholt Universal Hollow Hexagon, m. d.
No. 5 Gisholt Ram Type, m. d.
No. 5 Jones & Lamson Ram Type, m. d.
No. 5 Warner & Swasey Universal Ram Type, m. d.
No. 5L Gisholt, block hard ways, 1953
No. 7A Jones & Lamson Universal, m. d.
No. 8A Jones & Lamson

MISCELLANEOUS

18" Grob Filer
P.C. 14 N Jones & Lamson Comparator
2000# Niles Single Frame Steam Hammer
100# Bradley Rubber Cushioned Helve Hammer, m. d.
No. 90H Williams & White Justice Hammer, single pulley drive
No. 125 Marken Marking Machine, m. d.
Sciaky Type PMCO-28-31 Storage of Energy Spot Welder, 50 KW, 34" throat
Pratt & Whitney Standard Measuring Machine, 36" capacity
15" Gleason Quenching Press
Le Roi Electric Power Plant
38" face Plate, Lathe, taper key mounted, new
Clamping Assembly to fit a 6.2 Denver Acme Turret Lathe
1 ton Shaw Electric Cable Hoist
Brown & Sharp Universal Attachment, for use on 2A Brown & Sharp Miller
No. 74 Heald Workhead Assembly
6" Victor Swivel Vise, new
No. 00 Ingersoll-Rand, "Multivan" Air operated hand grinder, new
King Boring Mill Table, 32" diameter, 4 jaw independent chuck, new
48" diameter Cleveland Universal Jig Co., Rotary Table
57" diameter Cleveland Universal Jig Co., Rotary Table
Jones & Lamson Automatic Die Head Hartness No. 7H
No. 26 Norton Hyproiap, m. d., late
Cincinnati Vertical Boring Mill Right Hand side head with turret
Type 114-CB Moline Tool Boring Machine, 2 spindle type, m. d.
9x9" Curtis Model A Air Compressor
No. H70 P-30 ton Pull Type Grennard Hydraulic Arbor Forcing & Assembly Press
Hanson & Whitney Single End Centering Machine, m. d.
4 spindle Pratt & Whitney Model N-1736 Auto. Duplicating Mach., m. d., new
No. 56 Sundstrand Double End Centering Machine, m. d.

WRITE FOR COMPLETE STOCK LISTING
The above is only a partial listing

THE EASTERN MACHINERY COMPANY
1006 Tennessee Avenue, Cincinnati 29, Ohio • MElrose 1-1241 • Cable Address EMCO

BOOKS . . . give you the answers to your design and production problems. And it's easy to get them by mail. Just read the descriptions on the insert opposite the back cover, and use the prepaid order card to get the ones you want.

EXPERIENCED

Technical book editor with degree in Mechanical Engineering wanted for work on metalworking, mechanical design and associated technical titles. Shop or design experience desirable. State experience and salary. Location, New York City. Box 734,

MACHINERY
93 WORTH STREET
NEW YORK 13, N.Y.

Rising costs, can be met by ***rising sales only.*** If you want to expand your sales and to obtain a foothold (production facilities) in the Euromarket, write to:

GEBROEDERS NAEFF
N.V. Lochem—Holland

Alphabetical Index of Advertisers

Alphabetical Index of Advertisers

feel free to use cards below . . .

to obtain free literature on products advertised or described in this issue

1. Circle page numbers of advertisements—if no page number appears on ad, refer to advertisers' index.
2. Circle item numbers of new equipment, catalog descriptions.
3. Mail . . . we'll do the rest.

For Advertisements—Circle Page Numbers

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	158	159	163	164
166	167	169	171	174	175	177	179	181	183	187	193
195	196	197	199	201	202	203	204	205	206	207	208
209	210	211	212	213	214	215	216	217	218	219	221
222	223	224	225	226	227A	227B	227C	228	229A	229B	229C
230	231A	231B	231C	231D	232	233A	233B	233C	235	236	750
752	754	800	816	817	818	819	820	821			

COVERS: FRONT — INSIDE FRONT — INSIDE BACK — BACK

For New Equipment, Catalogues—Circle Item Numbers

501	502	503	504	505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520	521	522	523	524
525	526	527	528	529	530	531	532	533	534	535	536
537	538	539	540	541	542	543	544	545	546	547	548
549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572
573	574	575	576	577	578	579	580	581	582	583	584
585	586	587	588	589	590	591	592	593	594	595	596
597	598	599	600	601	602	603	604	605	606	607	608
609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632
633	634	635	636	637	638	639	640	641	642	643	644
645	646	647	648	649	650	651	652	653	654		

Please print 6/61

NAME .....

TITLE .....

COMPANY .....

CO. ADDRESS .....

CITY .... ZONE .... STATE .....

For Advertisements—Circle Page Numbers

1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	158	159	163	164
166	167	169	171	174	175	177	179	181	183	187	193
195	196	197	199	201	202	203	204	205	206	207	208
209	210	211	212	213	214	215	216	217	218	219	221
222	223	224	225	226	227A	227B	227C	228	229A	229B	229C
230	231A	231B	231C	231D	232	233A	233B	233C	235	236	750
752	754	800	816	817	818	819	820	821			

COVERS: FRONT — INSIDE FRONT — INSIDE BACK — BACK

For New Equipment, Catalogues—Circle Item Numbers

501	502	503	504	505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520	521	522	523	524
525	526	527	528	529	530	531	532	533	534	535	536
537	538	539	540	541	542	543	544	545	546	547	548
549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572
573	574	575	576	577	578	579	580	581	582	583	584
585	586	587	588	589	590	591	592	593	594	595	596
597	598	599	600	601	602	603	604	605	606	607	608
609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632
633	634	635	636	637	638	639	640	641	642	643	644
645	646	647	648	649	650	651	652	653	654		

Please print 6/61

NAME .....

TITLE .....

COMPANY .....

CO. ADDRESS .....

CITY ..... ZONE .... STATE .....

information center

Reverse side of this card gives instructions on how to use postcards below to obtain new catalogues, data on new equipment described, and products advertised in this issue.

This card expires September 1, 1961

FIRST CLASS
Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

MACHINERY
93 WORTH STREET
NEW YORK 13, N.Y.

READERS' SERVICE DEPT.

This card expires September 1, 1961

FIRST CLASS
Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

MACHINERY
93 WORTH STREET
NEW YORK 13, N.Y.

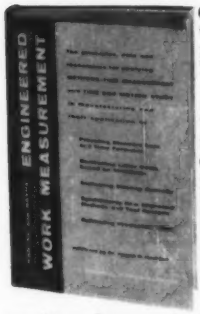
READERS' SERVICE DEPT.

BUILD YOUR OWN ENGINEERING LIBRARY
ORDER THE ONES YOU NEED TODAY

Order Them by Mail

ENGINEERED WORK MEASUREMENT

by Delmar W. Karger and Franklin H. Bayha



Comprehensive treatise on solving problems of Methods - Time Measurement (MTM) and Time and Motion Study, to establish efficient procedures. History, fundamentals, mathematics, applications, standards of MTM . . . and complete tables and official MTM working data card are included. 630 pages, 120 illustrations.

$12.00

INDUSTRIAL LUBRICATION PRACTICE

by Paul D. Hobson

Practical working manual covering motors, engines, turbines, compressors, refrigeration equipment, machine tools, pneumatic and hydraulic tools, and other industrial and marine equipment. Chapters on oil purification and reclamation, use of cutting fluids, and storage preservation of machinery. 167 Illustrations. 534 Pages.

$8.00

DIE-CASTING—2nd Edition

by Charles O. Herb

Illustrates and describes the latest die-casting machines. Tables of die-casting alloy composition, the latest developments, discussion of their properties and applications. 196 Illustrations. 310 Pages.

$5.00

MATHEMATICS AT WORK

by Holbrook L. Horton

100 pages of reviews of the fundamentals of arithmetic, algebra, genometry, trigonometry and logarithms. 482 pages of illustrated mechanical problems with step-by-step analyses and solutions. 146 pages of standard mathematical tables needed for all types of problem solving. 196 Illustrations.

$7.50

GEAR DESIGN SIMPLIFIED

by Franklin D. Jones

In chart form. Contains 110 gear-problem charts and worked-out examples of gear design that show exactly how rules are applied in obtaining essential dimensions, angles, or other values. 201 Drawings. 134 Pages.

$4.50

NEW!
BROACHING—TOOLING AND PRACTICE

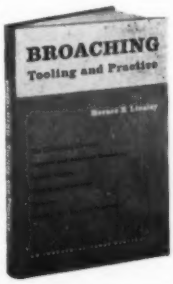
by Horace E. Linsley

In these days of rapidly mounting production costs, the techniques of broaching are being ever more widely adopted because of their ability to remove more metal in less time than any other process.

This book covers the entire field of broaching—internal, external, vertical, and horizontal, and explains how each type of machine operates, and for which type of work each is best suited. The design of broaching tools and fixtures is covered in detail, and examples of special and unusual broaching operations are given. The book is well illustrated and also has tables of data for broach ends. This new book will be of great value to manufacturers in the metalworking field who are interested in reducing production costs, as well as to tool and manufacturing engineers responsible for the design of broaching tools and fixtures.

CONTENTS

1. The Broaching Process
Classification — Limitations — Broachability of Materials — Definitions
2. Internal Broaching
Rotary-cut — Double-cut — Blind Hole — Strip — Square Hole — Spline
3. External Broaching
Serrations — Rack and Gear Teeth — Slotting — Curved Surfaces — Rotary Broaching
4. Broach Design
About The Work — About The Machine — About The Broach
5. Broaching Machines
Vertical — Pull-up — Pull-down — Horizontal — Double Ram — Automation — Work Tables
6. Fixtures
Positioning Round Parts — Workpieces Which Do Not Lie Flat — Fixtures for Broaching Helical Splines
7. Setting Up, Trouble Shooting
Broach Stuck In Work — Galling and Pickup — Broach Breakage



224 Pages $6.50
162 Illustrations

MACHINE TOOLS—What They Are and How They Work

by Herbert D. Hall and Horace E. Linsley

Introduction to fundamentals of mass production. Covers each machine tool, how and where it functions, skills and organization that make modern mass production possible. A basic, thorough text on all phases of metalworking operations. 363 Illustrations. 488 Pages.

$5.50

DIMENSIONS AND TOLERANCES FOR MASS PRODUCTION

by Earle Buckingham

An analysis of the many problems of dimensioning with tolerances for mass production, showing their effect on tool design, gage design, production and inspection, and suggesting improved methods and practices to solve these problems. 179 Illustrations. 164 Pages.

$8.00

DIE DESIGN AND DIEMAKING PRACTICE

3rd Edition—
by Franklin D. Jones

Drawings and descriptions of a tremendous variety of dies and a vast amount of data to help you avoid expensive mistakes and delays. A standard reference work in the metal working industries, used by some 40,000 diemakers, designers and tool engineers. 661 Illustrations. 1083 Pages.

$10.00

THE NEW PRODUCT

by Delmar W. Karger

It describes in detail how to find ideas, how to test, develop and sell new products. Useful checklists are provided to aid a manager in avoiding common pitfalls and at the same time help him secure the step-by-step success of his project. 21 Charts & Illustrations. 234 Pages.

$5.00

FIRST CLASS
Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

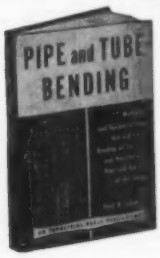
THE INDUSTRIAL PRESS
93 WORTH STREET
NEW YORK 13, N. Y.

BOOK DEPT.

WHICH OF THESE INDUSTRIAL PRESS BOOKS CAN BE MOST VALUABLE TO YOU?

Order Them by Mail

PIPE AND TUBE BENDING



by Paul B. Schubert

Defines the six basic ways by which the bending of ferrous and non-ferrous pipe and tube may be accomplished. Descriptions of methods, applications and features of the equipment available. 159 Illustrations. 183 Pages.

$6.00

MANUAL OF GEAR DESIGN—3 Vols.

by Earle Buckingham

Vol. I: mathematical tables, especially applicable to gear design. Vol II: simple formulas and time-saving tables for solving spur and internal gear designing problems. Vol. III; formulas, charts and tables used in designing and "spiral" gears for non-parallel, non-intersecting shafts.

Complete Three-Volume Set, **$15.00**

Any Single Volume, **$6.00**

HELICAL SPRING TABLES

by John D. Gayer and Paul H. Stone, Jr.

Index of over 6800 ready-designed compression and tension springs from which selections may be made with minimum calculation. 165 Pages.

$5.00

INGENIOUS MECHANISMS FOR DESIGNERS AND INVENTORS

Volumes I and II by Franklin D. Jones
Volume III by Holbrook L. Horton

A comprehensive encyclopedia of mechanical movements unparalleled in scope and usefulness. Each volume is an independent treatise. Similar in size and general character, the contents are different. Tells *what* each mechanism consists of, *how* it operates, and the features which make it of special interest. Hundreds of illustrations.

Single Volume, **$7.50**

Complete Set, **$20.00**

NEW!

DESIGN OF WORM AND SPIRAL GEARS

by Earle Buckingham and Henry H. Ryffel

This book has been written for people who are not satisfied with the results they are now getting from their worm gear units as regards either life or load-carrying ability. The text explains what happens at the mesh of a worm and its mating worm gear when they are operating under load, and shows how the use of all-recess-action can provide up to 500% better performance than drives of conventional design without proportionately higher costs.

DESIGN OF WORM AND SPIRAL GEARS does two jobs: (1) It provides a step-by-step guide to the design of worm and spiral gear drives with all-recess action and (2) it presents certain basic principles and practices which enter into the successful design and manufacture of gears and gear drives of all types.

The topics covered are: Worm Gear Geometry, Contact Conditions And Nature of Action; 14½° Linear Pitch Worms; 20° Linear Pitch Worms; 25° Linear Pitch Worms; Selection and Design of Worms; Design of Reduction Drives; Design of Worms for Step-up Drives; Diametral Pitch Worms; Design of Spiral Gears; Fine Pitch Worm and Spiral Gear Drives; Contact Analysis, Screw Helicoid; Contact Analysis, Involute Helicoid Lubrication, Friction and Wear; Dynamic Loads on Spiral Gears; Dynamic Loads on Worm Gear Drives; Beam Strength of Teeth; Limiting Wear Loads for Spiral and Worm Gears; Tooth and Bearing Loads; Analytical Design of a Worm Gear Drive; Analytical Design of a Spiral Gear Drive.

464 Pages
98 Tables
159 Illustrations

$15.00

ENGINEERING ENCYCLOPEDIA

by Franklin D. Jones

Condensed and practical information on 4500 subjects definitions of numerous terms used in engineering and manufacturing practice, the results of many costly and important tests and experiments. No single work will give you a broader knowledge with less reading effort. 206 Drawings. 1431 Pages.

NOW in ONE Volume, $10.00

MACHINERY'S MATHEMATICAL TABLES

Edited by Holbrook L. Horton

This book has been serving mechanical engineers, machine designers, draftsmen, toolmakers, machinists and students for over 30 years(Now it is available in a greatly enlarged version, containing the authoritative, easy-to-use mathematical tabular information you need on the job. Designed for speed and utility. 254 Pages.

$3.75

MACHINE SHOP TRAINING COURSE

by Franklin D. Jones

Contains 1124 pages of questions and answers, shop problems and solutions, blueprint reading charts. Illustrated by 572 drawings and photographs. For use as a textbook or for designers and production engineers who want the fundamentals of machine shop practice.

Two-Volume Set, **$9.00**

Single Volume, **$5.50**

CHIPLESS MACHINING

by Charles H. Wick

This is a how-to volume. It describes the essential steps in making parts by various chipless methods. It is a practical guide to the design and selection of machines, tools and accessories.

CHIPLESS MACHINING explains the range of various processes, their advantages and limitations—and their typical applications. 502 Pages.

$10.00

JIG AND FIXTURE DESIGN

by Franklin D. Jones

A thorough coverage of the principles of development and constructional details of jigs and fixtures. Designs show principles of construction that can be applied successfully to a variety of jig and fixture design problems. 345 Illustrations. 406 Pages.

$6.00

SELLING TO INDUSTRY

by Bernard Lester

64 articles on how you can do a better sales engineering job. Covers the problems encountered in selling industrial products or services and discusses successful selling techniques. Case histories. 255 Pages.

$4.00

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y.

Please send me the following books.

☐ Bill me ☐ Bill company ☐ Payment enclosed, send books postpaid
Orders from foreign countries, except Canada, must be accompanied by payment in full including 50¢ per book, postage and handling.
☐ Send me complete catalog and details of time payment plan.

. . . . . .

. . . . . .

. . . . . .

NAME . . . . . .

COMPANY . . . . . .

COMPANY ADDRESS . . . . . .

CITY . . . . . ZONE . . . . . STATE . . . . . .

HOME ADDRESS . . . . . .

CITY . . . . . ZONE . . . . . STATE . . . . . .

(please fill in home address only if you want books sent there)

0052

CAPE-ABILITY means maximum band saw production

Realize your full production capabilities through the use of Capewell band saw blades because they can take the speed and feed any job requires. This is possible through advanced materials, manufacturing processes and quality control methods developed by Capewell:

- **Cravenizing, Capewell's exclusive process controls the position and degree of hardness in the cutting edge.**
- **Selected analysis steel specially processed for metal cutting saws, and in the case of Speed-Band a new double carbide alloy, L-100-M, was developed specifically by Capewell to provide a superior band saw blade.**
- **Electronically controlled tempering achieves proper tooth hardness.**
- **Microphotographic records maintained on every production lot insure product uniformity.**
- **Rigid inspection procedures at every step in the manufacturing process insure reliable and uniform performance of all bands.**

See your Capewell Distributor and realize your full production capability.

Hand Hack Saw Blades, Power Hack Saw Blades, Hole Saws, Hammers, Ground Flat Stock.

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

1881 CAPEWELL

THE CAPEWELL MFG. CO., HARTFORD 2, CONN.

5 big tool steel savings in one package

Wrapped and ready to use, precision ground flats of Graph-Mo® steel save 5 ways in making gages, dies and other tool steel parts. It's because . . .

1) **They're precision ground to size,** decarb free, ready for marking and cutting. You save costly stock removal.

2) **There's a 30% easier machining** with Graph-Mo than with conventional tool steels.

3) **Heat-treating response of Graph-Mo is uniform,** eliminates distortion in preparation.

4) **Graph-Mo outwears ordinary tool steels 3 to 1** because of the free graphite and diamond hard carbide in its structure.

5) **Special wrapping protects** Graph-Mo precision ground flats, assures top condition when you're ready to use them.

Graph-Mo is the only tool steel that combines the advantages of machinability, wearability and stability. More than 250 standard stock sizes of precision ground flats make possible maximum savings on many applications. And—there's only one Graph-Mo, and the Timken Company makes it. For stock list, call your local Timken steel distributor or write: The Timken Roller Bearing Company, Steel and Tube Div., Canton 6, Ohio. Cable: "TIMROSCO".

Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

TIMKEN®
***Fine Alloy* STEEL**

TIMKEN GRAPHITIC STEELS ARE AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES AND CANADA